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PC MAGAZINE

FIRST LOOKS

The Compaq Deskpro 50M: A Home for the First of Intel's Clock-Doubling Chips

INDUSTRY INSIGHT

John C. Dvorak Warns of New "Stealth" Virus Threat

GRAPHICS

True Color at Gray-Scale Prices: 9 Desktop Scanners That Do It Right

TAPE BACKUP

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Notebooks

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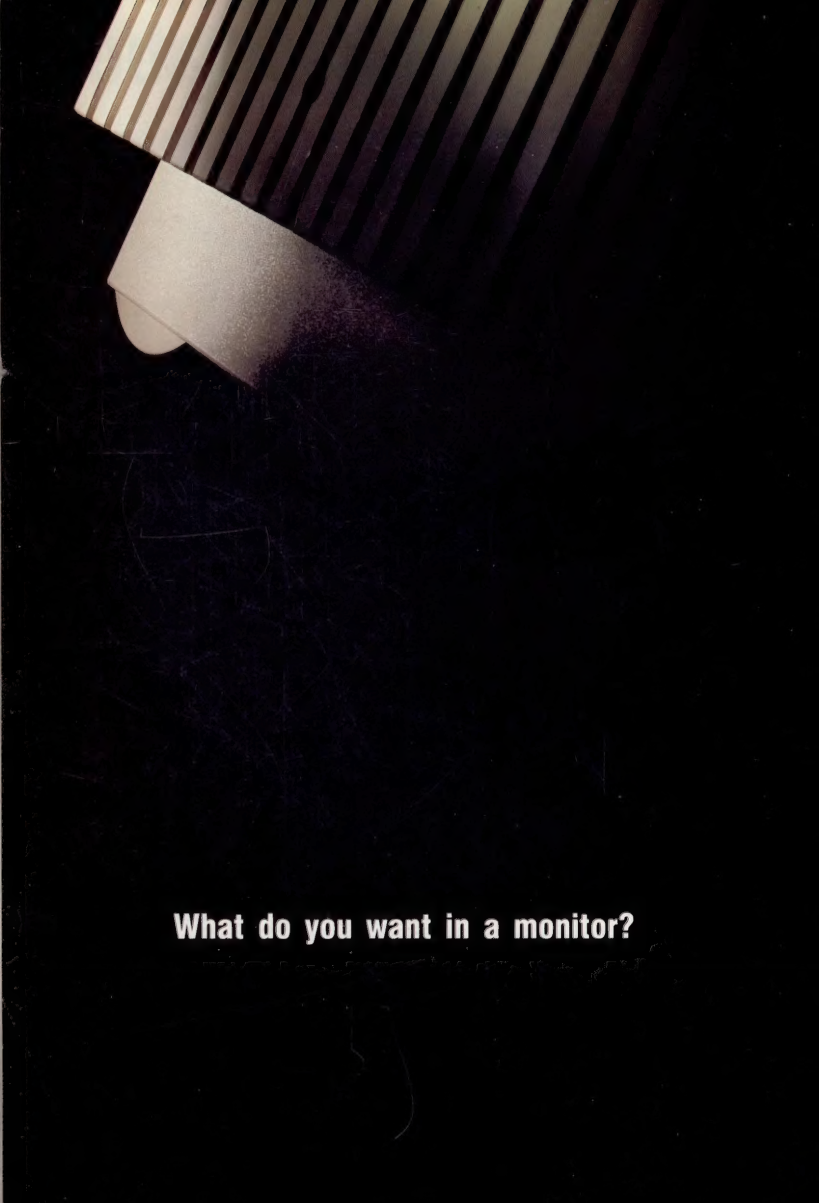

What do you want in a monitor?

MultiSync 46F

Creating borders in Word for Windows was easy for test participants – they simply chose the easy-to-locate "Border" command.

Exotic Excursions
23 Cajun Court
New Orleans, LA 36857

May 15, 1992

Steve Sullivan
8762 W. 180th Pl.
San Diego, CA 98034

Dear Steve:

During the past two years **Exotic Excursions** has seen a record 200% growth in revenues. This success has been exciting, but we now must adjust for our very fast growth. The size of our office impedes proper customer service and is inadequate for the increased level of store traffic.

- I propose that we open another **Exotic Excursions** office, since our phenomenal growth of the past three years is likely to continue.
- ***Thousands of potential clients will attend the grand opening of the new Exotic Excursions office.***

Bold or italics? It was easy with one click of the mouse.

Creating a bulleted list was two steps in Word for Windows and 12 steps in WordPerfect for Windows.

My staff are currently inspecting some potential locations in the Bay Court Plaza. Rental agents have told us that almost 10,000 people pass through this retail space weekly on their way to offices, restaurants, and shops. The table below shows cost projections for three different space configurations.

Location	Floor	Meeting	Bath	Street	Cost/Sq.
Court A	4500	N	Y	Main	$2100
Court B	2100	N	N	Main	$590
Court C	3400	Y	Y	52nd	$1000

Word for Windows has an on-screen "Tables" function that lets you add rows almost instantly.

I recommend that we lease the Court C location. This ...
It is substantially ...

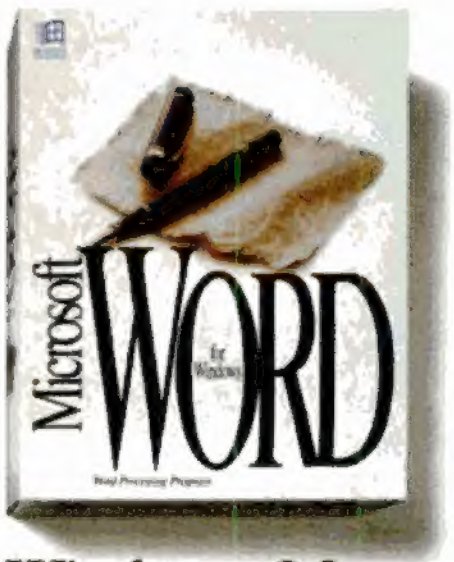
Exotic Excursions
23 Cajun Court
New Orleans, LA 36857

Steve Sullivan
8762 W. 180th Pl.
San Diego, CA 90834

Printing envelopes? Easy. We mean REAL easy. There's an envelope command right on the screen that addresses and prints automatically.

When given this simple letter to revise, WordPerfect for DOS users were impressed at how easy it was to perform everyday word processing tasks using Microsoft Word for Windows 2.0.

No wonder WordPerfect users prefer Word for Windows. It has easy written all over it.



In a recent test conducted by the National Software Testing Labs (NSTL), nearly eight out of 10 WordPerfect* for DOS users preferred Microsoft® Word for Windows™ 2.0 over WordPerfect for Windows. The reasons were plenty.

They were amazed at how Word for Windows put them one step away from accomplishing everyday word processing tasks with, in many cases, one simple click of the mouse. Which may have surprised them. But it didn't surprise us. After all, we designed Word for Windows around them.

Every week during the development of Word for Windows, we invited WordPerfect users to bring in their letters, memos, or whatever business documents they use in their own jobs, and try them out using Word for Windows. Our Product Development people at Microsoft called these sessions "usability studies." Which is just a fancy, shorter way of saying "what-do-people-use-a-word-processor-for-and-how-can-we-make-it-easier-for-them-to-use-it."

These studies not only helped us to design features that make everyday tasks easier, but helped us to make the more advanced word processing features like grammar checking, drawing and charting, easier to use as well.

See for yourself why nearly eight out of 10 WordPerfect users preferred Word for Windows, and take advantage of our special $129 offer,* by calling (800) 323-3577, Dept. Y76. If, for any reason, you're not completely satisfied with Word for Windows 2.0, we'll gladly return your purchase in full.** If you'd like, we'll also send you the files you need to test Word yourself. Then you, too, can have the last word on ease.

Microsoft®

*Offer good for current licensees of WordPerfect, MultiMate,® WordStar,® MS® Word for MS-DOS® and DisplayWrite.® Please allow 2-4 weeks for delivery upon receipt of order by Microsoft. Offer expires 6/30/92. Limit one per customer. Reseller prices may vary. Call for system requirements. **If you're not satisfied with Word for any reason, return the product to Microsoft within 90 days with proof of purchase for a full refund. Offer good only in the 50 United States. To receive only the NSTL test results: In the United States, call (800) 323-3577, Dept. Y76. For information only: In Canada, call (800) 563-9048; outside the U.S. and Canada, call (206) 936-8661. © 1992 Microsoft Corporation. All rights reserved. Printed in the USA. Microsoft, MS, and MS-DOS are registered trademarks and Windows is a trademark of Microsoft Corporation. WordPerfect is a registered trademark of WordPerfect Corp.

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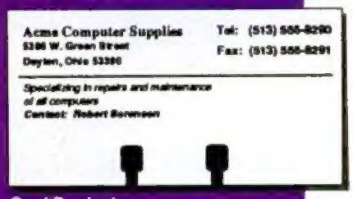

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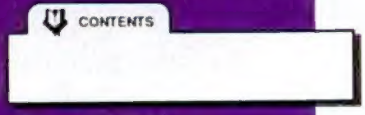

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Inside

"If it ain't broke, don't fix it" is a popular adage, but it's not very applicable around here. Instead, we tend to believe that if it works, it can be made better. PC Magazine Labs is one of the things that works, and in the past several months it has been improved with a redesign and expansion that has made it 50 percent larger, better staffed, and better equipped. It has also served as the model for a new lab that serves all of the Ziff-Davis publications.

Located in Foster City, California, ZD Labs is in the heart of the industry, a stone's throw from major chip makers, board vendors, connectivity companies, and computer manufacturers. It's the primary testing site for our publications that don't have lab facilities, and it is also equipped to handle special projects that are too big for even PC Magazine Labs to undertake, such as testing superservers with a hundred or more users. The newly completed lab also houses a small IBM mainframe and several minicomputers, and over 100 Macintoshes, to make it easier to test diverse multiplatform products. High-speed communications lines can link the new lab with existing Ziff-Davis labs in New York, Massachusetts, California, and Europe, providing real-life operating conditions for testing products that must operate among multiple sites, or even across international boundaries.

ZD Labs' LAN test facility houses hundreds of machines and has more than 25 miles of wiring.

ZD Labs will also take on complex environmental and human-factor issues such as high-frequency and low-frequency electromagnetic radiation. Specially shielded rooms and sensitive measuring equipment will track vendors' progress in reducing emissions. Another room is tailored to monitor glare and measure quality, a third is equipped for sound level and thermal testing. A large inventory of PCs stands ready to provide identically performing platforms for software testing.

ZD Labs will develop new suites of tests for a wide variety products. Lab staffers build custom hardware and software to execute the tests required by the various Ziff-Davis publications. The lab is also the repository for all the company's test results, which are automatically stored in a central database, with minimal human intervention. This database provides key research for our editors, who can instantly compare any machine with any other, using consistent benchmark test results. *PC Magazine*'s famous and highly regarded laboratory benchmark test programs are being adopted by all Ziff-Davis publications, which will greatly increase the compatibility of test results among our publications.

PC Labs and ZD Labs are working together to bring you the finest testing and product evaluation available anywhere.—**Bill Machrone** ■

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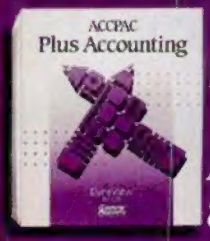

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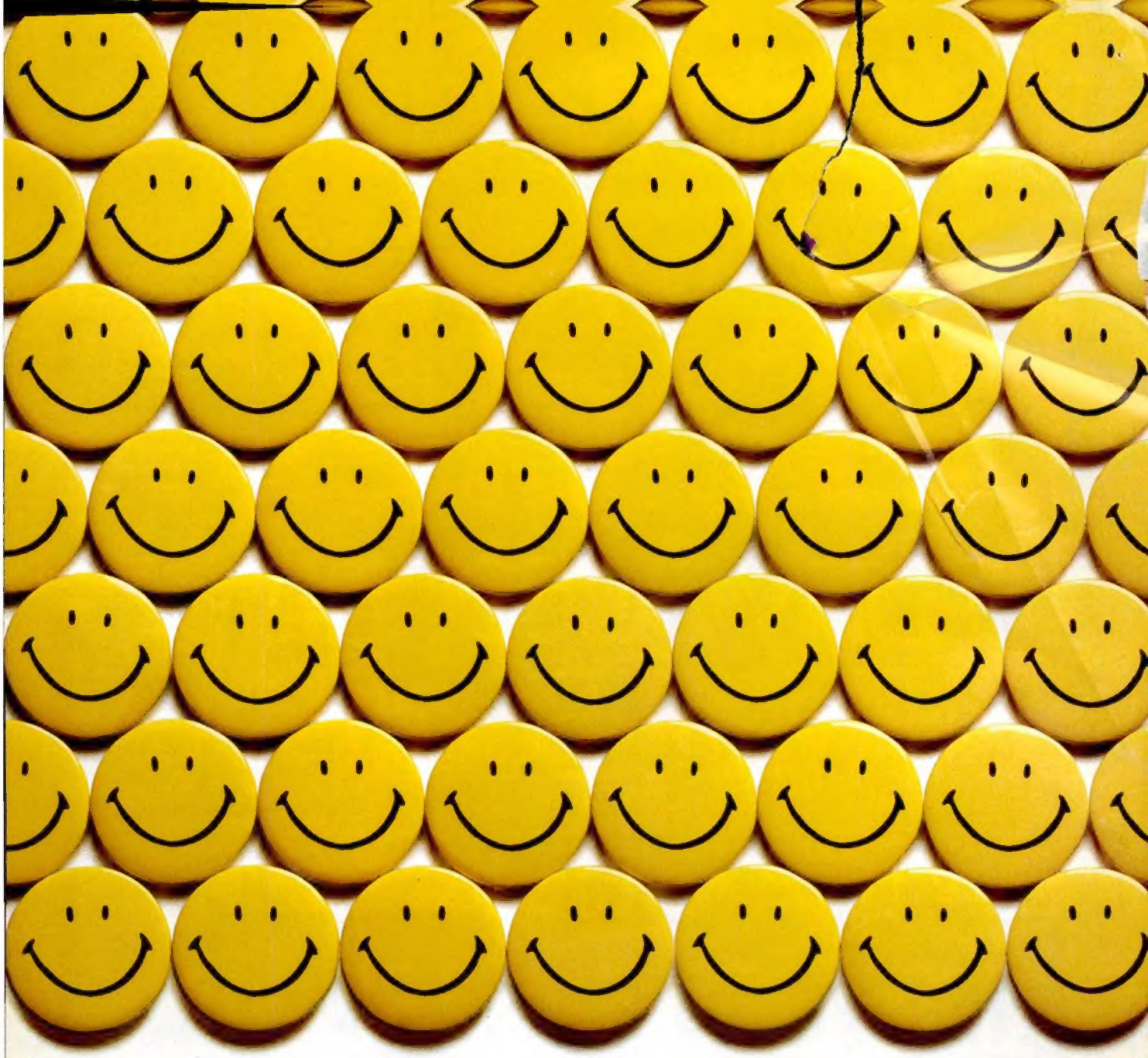

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And we're announcing 13 new AS/400s* to make the smiles even bigger.

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And the entire line of AS/400s has just been refreshed, with good news on all fronts—price/performance, openness, systems manage-

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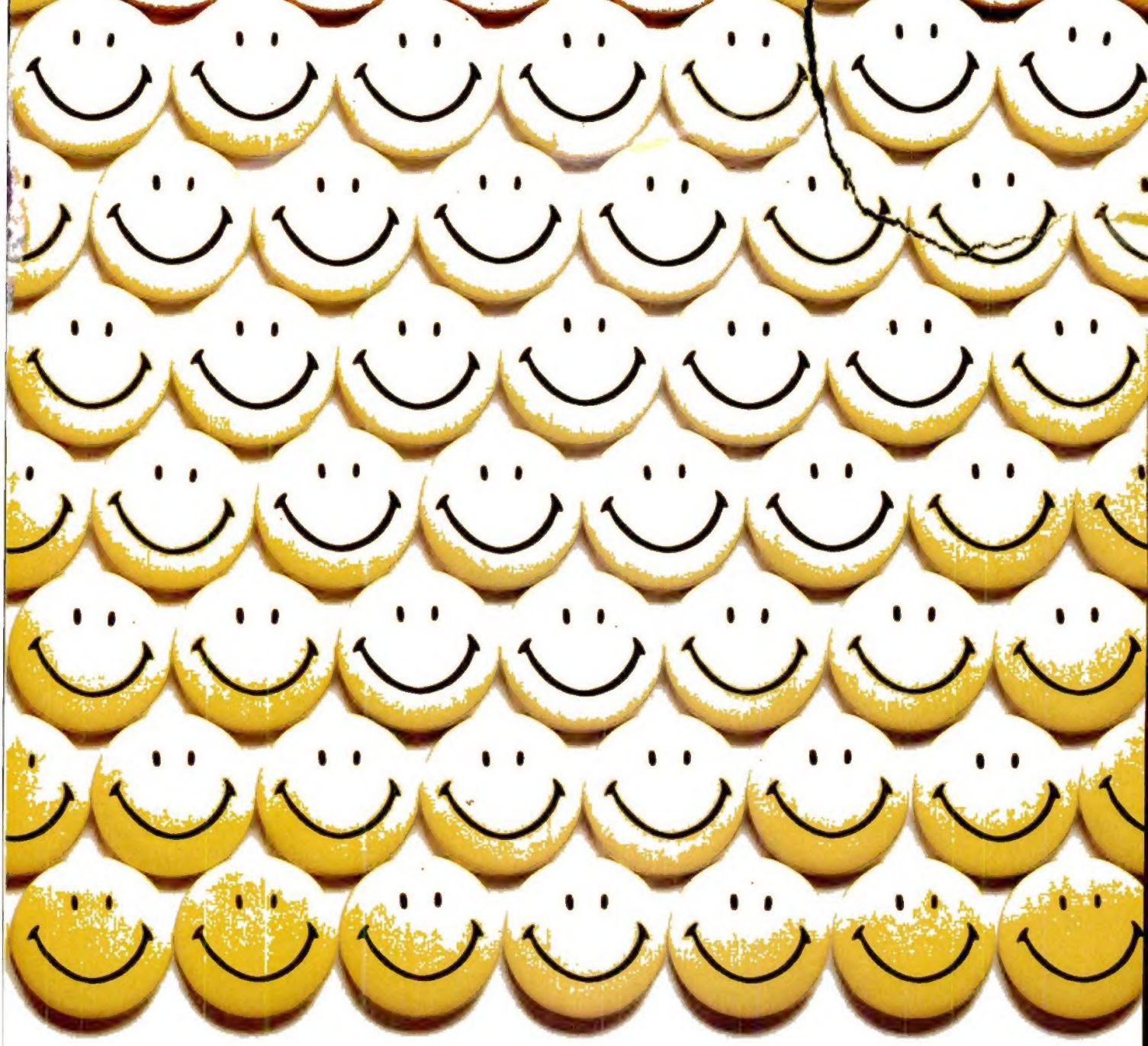

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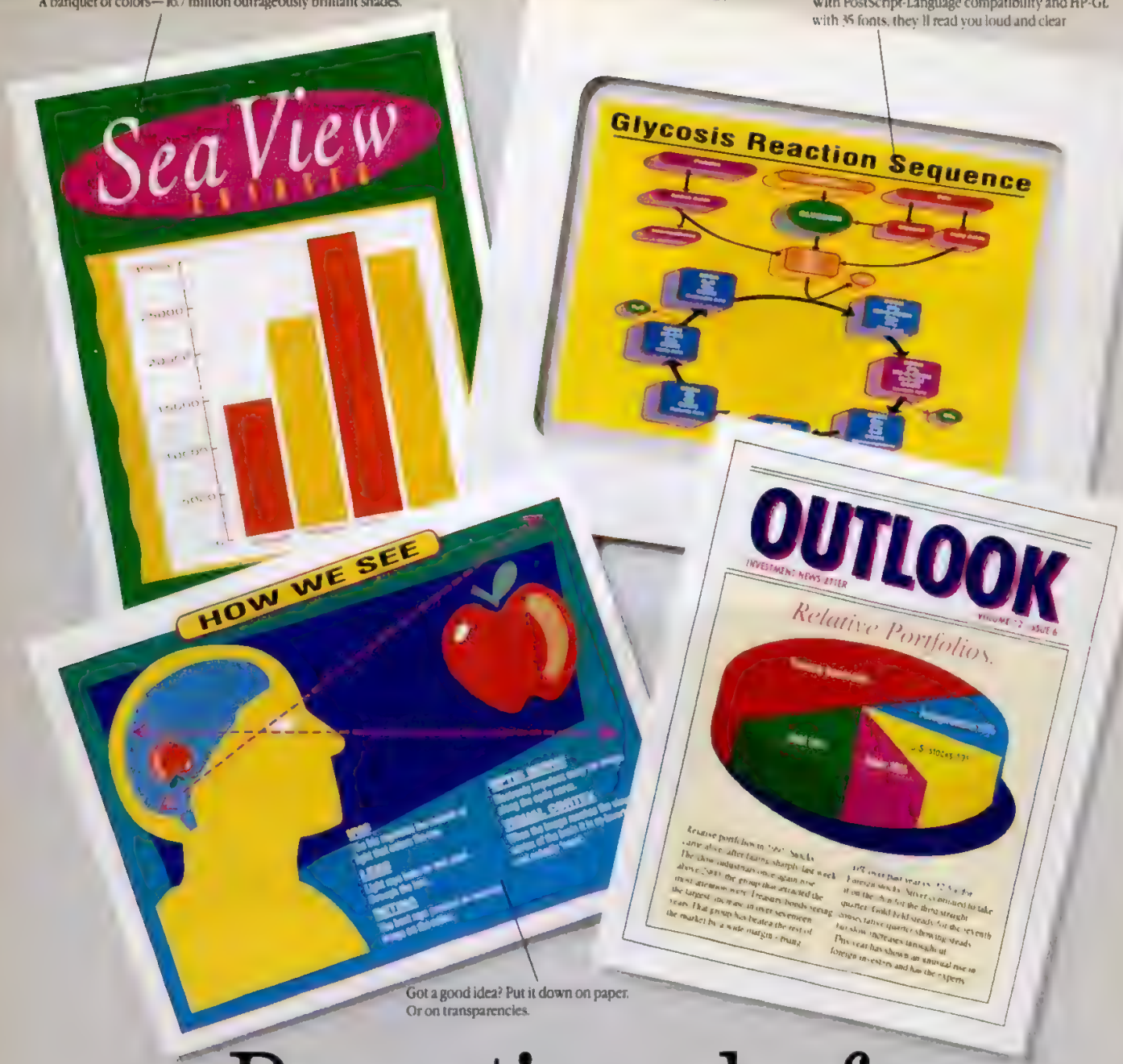

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Letters

TWO MORE CENTS WORTH ABOUT WINDOWS

I'm glad to hear that you've finally discovered that it's not just all those cutesy pictures that make Windows so slow ("Why We Hate Windows," January 14, 1992). No matter how much high-powered hardware you throw at it, you still have to play toy poodle and jump through six hoops to get Windows to do anything. Maybe the feature should have been titled "How We Learned to Lick Bill Gates's Face and Love Windows." When Dvorak starts wagging his tail about Windows I'm out of here—maybe sooner if you keep barking all day and all night about that doggy in the Windows.

Bruce Miller
Derby Line, Vermont

In your "Best of 1991" cover story, you had a page devoted to "Why We Hate Windows." Windows displays the "Unrecoverable Application Error" or UAE, when an application attempts to write to a memory location that doesn't belong to that application. This is the result of sloppy programming by a software developer and could easily have been prevented with a more thorough review of the source code. As a veteran Windows software developer, whenever a UAE shows up while testing my software, I can *always* track it down to a buffer being overwritten in the source code. So whenever I see the horrible UAE message, I blame the application's software developer, not Windows.

Howard Myers
Parlin, New Jersey

I cannot help adding my two cents worth to the letters regarding Windows UAEs (Letters, January 28, 1992). When I first experienced a couple, I, too, was told by Microsoft Technical Support that not only was there nothing they could do to help me, but also that UAEs were very unusual and that I should not be bothered much by them. What a laugh!

The vendors that deserve to prosper are those that not only produce well-thought-out products but also provide superb support for the inevitable problems. *WordPerfect* is the most often-cited example. The company has its share of problems, but you can reach them, you can get an answer, and if you require an update to your software, it's done reasonably promptly and at no charge. Colorado Memory Systems is another that has provided such service. Unfortunately, they are in the minority.

Torrey Everett
Delray Beach, Florida

Our readers never seem to get tired of talking about Microsoft Windows 3.0.

MEASURING THE 486SX'S WORTH

Intel would like to take issue with two recent articles published in *PC Magazine*. The first, Jim Seymour's column "486SX—Great for Intel, but What About You?" in the December 31, 1991, issue, claims that Intel's 20-MHz 486SX-based systems perform slower than Intel's 33-MHz 386DX-based systems. In "386/40 PCs: Faster, Cheaper, and Compatible, Too" (January 14, 1992), you claim systems based on AMD's 40-MHz 386 have a performance advantage over Intel's 25-MHz 486DX-based systems.

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Paul Otellini
Vice President and General Manager
Intel Microprocessor Products Group
Santa Clara, California

I enjoyed Jim Seymour's column, "486SX—Great for Intel, But What About You?" However, he failed to mention the most obvious rationale for the existence of the 486SX chip. What better way to recoup losses from a production run where the floating-point unit (FPU) is defective than to simply add an "SX" to its label and sell it anyway? We may even find that the 80487 FPU chip is nothing more than a flawed 80486 with a CPU that does not function but has a good FPU!

O. Clyde Bales
Arvada, Colorado

LEAVE FLOPPIES IN NOTEBOOKS

Although I generally have a great deal of respect for Jim Seymour's opinions, I take exception to his diatribe against

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internal floppy disk drives in notebook computers ("7-Pound 'Notebooks?'" February 11, 1992). For me, an internal drive is indispensable.

How does Mr. Seymour propose to back up files while traveling without this "unnecessary" accessory? An external drive might serve, but that would require bringing it along, which defeats the whole purpose. Also, with the disk-hungry size of today's software, unless the internal hard disk is at least 40MB, it gets crowded very quickly. In addition, the constant spinning of the hard disk runs down the notebook's battery.

As a computer user for more than 20 years, perhaps I am less bothered by floppy swapping and more paranoid about data backup and file integrity than some of my colleagues. Mr. Seymour doesn't have to use a notebook with a floppy disk drive if he doesn't want to, but for those of us who do, let us have ours.

Stephen F. Scheiber
Schenectady, New York

THE NEXT DOS

I find it interesting to read that "the next DOS will probably have file-transfer abilities built in." (Trends, January 28, 1992.) Since that feature *is* built into DR DOS 6.0, the next DOS is here now. Seriously, it's obvious from the context that Bill Howard was talking about the next version of MS-DOS, but it's interesting that Microsoft is playing catch-up yet again. Similarly, I hope William F. Zachmann is right in saying "excellent products are likely to succeed eventually. . .It just takes them a little longer." ("Does the Best Product Always Win?" January 28, 1992.)

It might help if DR DOS users submit tips for the User-to-User column that reflect the differences between DR DOS and MS-DOS.

David Phelps
St. Louis, Missouri

VAPOR INCHES

I couldn't agree more with Mr. Novak's letter (Letters, January 28, 1992) concerning monitor size. Why can't the industry settle on a simple standard, the way the television industry has? When they say 13-inch diagonal, that's what you really get. People would riot if they thought they were getting a 19-inch diagonal TV and it was actually only 17 inches. The computer industry should give their customers more credit than trying to out-hype each other's specifications with virtually meaningless figures.

John Schmidt
San Rafael, California

COMPLAINTS DEPT.

There are two sentences that I find inexcusable but more prevalent every day. They've each caused me no end of frustration. The first comes from the purchasing department and goes something like this: "We know we can get item A from Vendor X for significantly less money, but we have to buy from Vendor Y." The second one comes from management and some fellow programmers: "We all agree that Borland C is a world better than Microsoft C, but we have to use Microsoft C because it is 'the standard.'"

George Warner
Lititz, Pennsylvania

Over the past several years I have purchased numerous computer products: software, PCs, printers—you name it, I've bought it. Yes, I've sent out those registration cards, but out of all those manufacturers, I only heard from three ever again.

Why can't companies, as a courtesy, send a card that says something like "Yes, we have received your registration card and thank you for your support"? I don't know whether the company ever received the card or if they just don't give a hoot. But I would like to thank ButtonWare, Symantec, and Novell. They always notify me when they have a new product or upgrade, and it makes me feel that my software purchasing dollar is appreciated.

David Gowin
Toronto, Ontario, Canada

Some software vendors have adopted the annoying custom of shipping 3.5-inch floppy disks with the write-protect tab missing. I suppose this practice started because of the occasional new user who doesn't flip the write-protect tab and manages to overwrite the disk, but for those of us who like to recycle and who acquire frequent upgrades, it would be nice to be able to conveniently reuse floppy disks without having to put tape on it so we can reformat and write over the outdated material.

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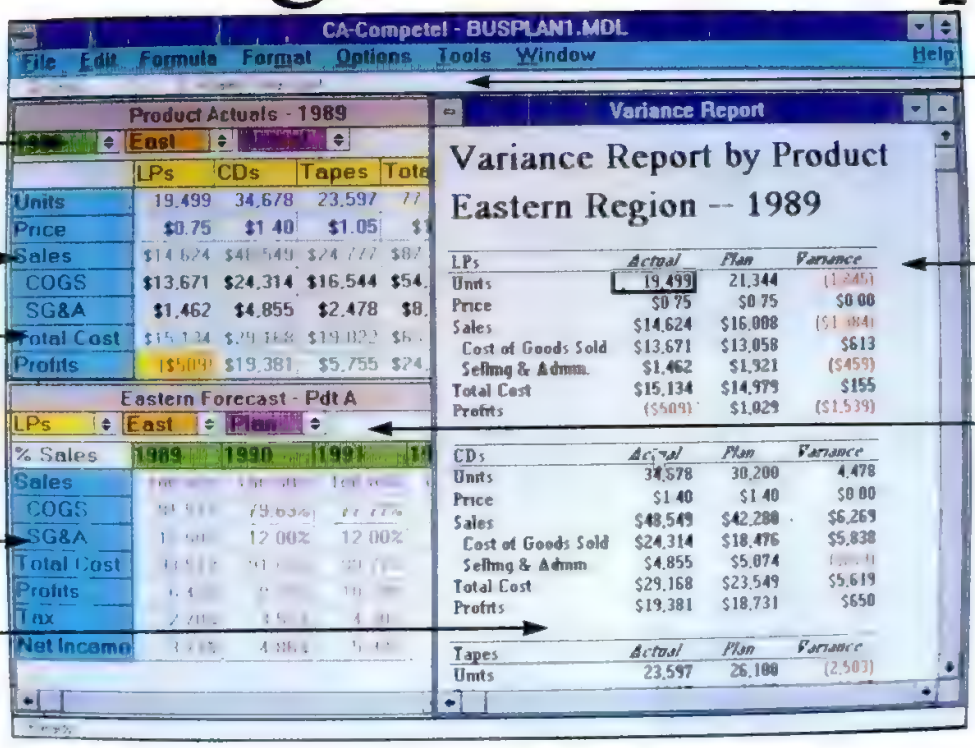

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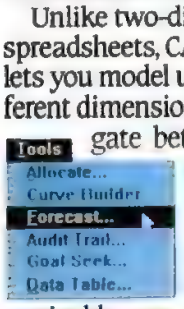

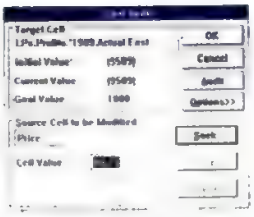

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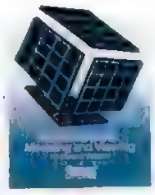

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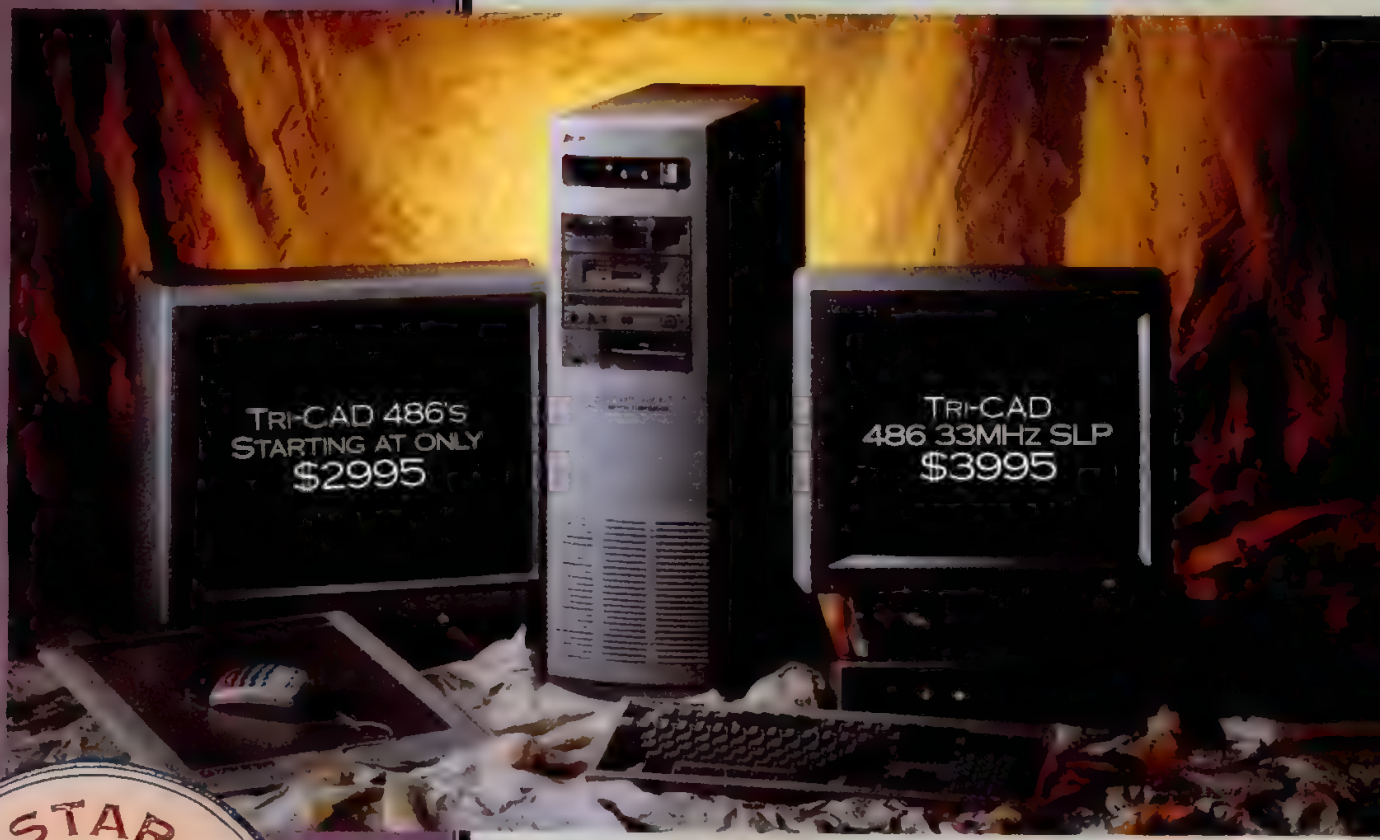

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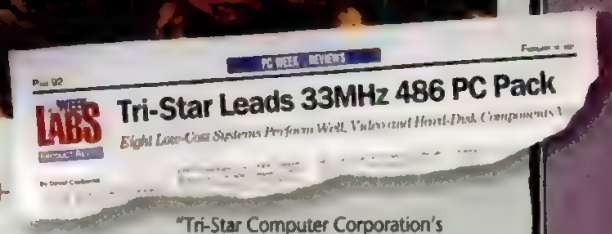

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April 1991 Crosstalk Mk.4 | April 30, 1991 Crosstalk Mk.4 Version 2.0 | Software Digest Vol. 7 No. 12 1990 Crosstalk Mk.4

CIRCLE 278 ON READER SERVICE CARD

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John E. Stith
Colorado Springs, Colorado

MONEY AND POWER COUNT

The December 31, 1991, 8th Annual Awards for Technical Excellence feature had Phillipe Kahn, photo and all, named as "Person of the Year." I might point out that Mr. Kahn got his start charging low prices, and after succeeding, increased prices to the higher industry-average prices, a rather dubious distinction.

Contrast this flowery treatment with the January 14, 1992, issue where the archive utility *LHA* was mentioned in "Editors' Favorites" in the "Best of 1991" cover story. In this piece, a little longer than Mr. Kahn's, no mention is made of the author's name! This in spite of the fact that he distributes the program free!

The impression I am left with is that money and power count for more than they should—at your magazine as well as in the world in general. For the record, the author's name is Haruyasu Yoshizaki.

Robert M. Johnson
Maryland Heights, Missouri

"THE ONE AND ONLY," YES, "FLOPTICAL," NO

While reading your January 14, 1992, issue, I came across the story "Sony Unveils 3.5-inch Rewritable Floptical Drive" (New & Improved). Although Sony may have a new drive, it is not a Floptical unit. The word Floptical is a registered trademark of Insite Peripherals, and is used when describing the Floptical disk drive, Floptical media, Floptical host adapters, Floptical products, and the Floptical Technology Association.

Joe Horne
Floptical Technology Association
Cupertino, California

DON'T COLOR MY PC, PLEASE!

It was with alarm that I read Douglas Thomson's letter (Letters, January 14, 1992) about how manufacturers can economically offer PCs in different colors. Dare we suggest a departure from a standard that works so smoothly and seamlessly that we scarcely know it exists?

Just as an unruly child is even more beautiful when asleep, all my beige-colored equipment is in perfect harmony when turned off. The Compaq portable blends in successfully with the NEC monitor sitting contentedly close to my dot matrix and laser printers.

I urge manufacturers to take a lesson from the Osborne: once the hottest portable computer available, until the case color was changed from the industry standard to a light gray. Next thing we know, the whole company goes down the toilet pulling CPM along with it! If I had to change computer colors, I wouldn't be able to afford another pair of trousers.

Tom Sadowski
Lincolnville, Maine

CORRECTIONS & AMPLIFICATIONS

In Advisor, February 11, 1992, the phone number for Microflip Inc. should have read 301-262-6020.

In "Future Currents: Where Wireless Technology is Headed," sidebar to "Portable, Affordable, Secure: Wireless LANs," (February 11, 1992, page 304) we should have stated that Telesystems SLW was the first company to gain approval in Britain for a wireless transmission allotment.

WinEZ, from New Generation Software, was mistakenly omitted from *PC Magazine*'s Editorial Product Index, (January 28, 1991, page 405). Furthermore, *SideBar*, actually from Paper Software, was attributed to New Generation.

In New & Improved Briefs, January 14, 1992, p. 64, we should have said that although the four new monitors are being sold by Wyse Technology, they carry the Amdek name. We should have listed the AM/732LC at $339. Also, the AM/738N is incorrectly identified as the AM/732N.

HOW TO WRITE TO PC MAGAZINE

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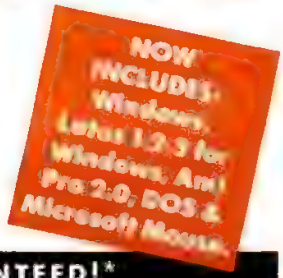

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Trends

Trends & Technology Shaping the Personal Computer Market

The Next Crop of Spreadsheets Will Play "What If"

Modern spreadsheet programs have evolved into huge, multifeatured programs since Dan Bricklin and Bob Frankston invented *VisiCalc* more than a decade ago. It was only three years ago that spreadsheets became graphics and presentation oriented, and the last features battle added AutoSum and Solvers. The next generation promises even more time-saving features.

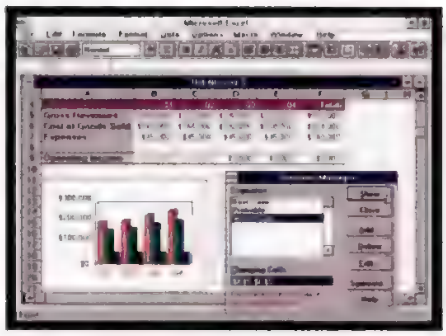
Borland International's *Quattro Pro for Windows*, Version 1.0; *Microsoft Excel* 4.0; and *Lotus 1-2-3 for Windows* 2.0—all due by summer—will make it easier to play "what if" games with your numbers.

The scenario manager in *Excel* 4.0, for instance, lets you keep different versions or alternative ranges of values in a single file. Without having to keep separate files on-disk for each model, scenario managers let you keep multiple "what if" models attached to a spreadsheet. You can specify "best-case," "worst-case," and "boss's-case" scenarios and deftly move from them to your own numbers. One set of data is substituted for another with simple pull-down menus. Since the alternatives are stored with your original, you won't clog your hard disk with extra versions of files.

Lotus, banking heavily on groupware like *Notes* and *cc:Mail*, is taking a workgroup approach to scenario management. The focus is on sharing spreadsheets. Using technology derived from the company's internal Chronicle research project, Version 2.0 of *1-2-3 for Windows* will let you save alternative ranges of values, with the benefit of annotations and *Notes*- or *cc:Mail*-provided user names and time stamps. This will give *1-2-3* users version and audit control when sharing the spreadsheet within the workgroup.

Borland takes a different approach to scenario building. Instead of creating a scenario by

CONTINUES ON PAGE 32



***Microsoft Excel* 4.0's scenario manager will let you attach multiple models to a spreadsheet.**

AMD Poised to Loosen Intel's 486 Grip

Last year, Advanced Micro Devices broke Intel's 386 chip monopoly, and history is about to repeat itself— only this time it's with the 486.

The chip maker recently announced six new 486 CPUs that should be in machines by the end of the year. And because they use Intel's microcode, AMD's chips promise to be 100 percent compatible with Intel's 486 processors.

The first configurations are expected to be pin-for-pin clones of 25-, 33-, and 50-MHz 486DX CPUs, and one 25-MHz 486SX. For the notebook market, AMD has plans for low-voltage 20- and 25-MHz DX chips.

AMD's entry into the 386 arena made a long-lasting impression. The company sold more than 2 million 386 chips. Third-tier computer makers found a solid supply of CPUs without shopping on the gray market. Users got to watch prices plummet and low-cost systems proliferate.

And although no performance gains have been announced, it wouldn't be out of character for AMD to ship a 486 CPU that actually outperforms Intel's. As an alternative source for *x*86 CPUs, AMD did more than simply force prices down—in two cases, it drove the market. Its 40-MHz 386 chip runs 20 percent as fast as Intel's highest 386 speed of 33 MHz. And AMD's 25-MHz 386SX, which Intel eventually matched, was a trendsetter.

It's too early to tell which computer makers will use AMD's new processors, but the likely prospects are second-tier system makers: AST, Everex, GRiD, NCR, Northgate, and Olivetti. All use AMD's 386 successfully and could easily incorporate the clone CPU into their designs.—*Christopher Barr*

Your Next PC Movie May Be Apple's

Motion video is still the enfant terrible of PC-based multimedia. There are many contenders but no standards for PC video compression or for a file format. The only thing that's clear about today's PC video is that it is better on the Apple Macintosh. Part of the Mac's success as a "video" machine is attributable to a new technology called QuickTime, an Apple-developed software architecture for multimedia. Fortunately, QuickTime's next showing may be on your PC, running under Windows.

Apple's QuickTime file format synchronizes video and audio and includes compression.

QuickTime is often characterized as a video format, but it's really an extension to the system software that stemmed from Apple's work in synchronized timing services. The format also includes compression schemes for graphics, animation, and video. When a QuickTime MOVIE file is created, synchronized reference points are

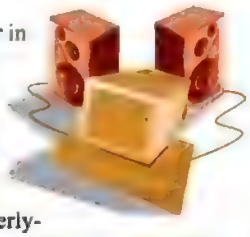
Pipeline

by Gus Venditto

Audio Age Is About to Begin

Windows 3.1 is likely to be a very big deal, though for some reasons you may not expect.

There's a lot in Windows 3.1 that will change the way people work. The OLE (object linking and embedding) utility is a big boost because it lets people create packages that combine data with executable programs. The printing system was overhauled with True Type, a new font system that matches display and printed output. And with most of the bugs fixed, it will be easier to incorporate Windows into the typical DOS-oriented workday.



But Windows 3.1 is also going to usher in the PC's audio age. If you create training programs, if your work involves any type of recorded sound, or if you're just plain tired of typing notes to people, Windows 3.1 will change the way you work because it will provide a couple of simple utilities for recording and playing sound, some underlying internal APIs (application program interfaces) for addressing sound boards that are compatible with the MPC (multimedia PC) standard, and features for linking sound clips with any application that uses OLE. It will be amazingly easy to integrate sounds into ordinary applications using almost any of the popular sound boards on the market, including those that sell for less than $100, such as the Sound Blaster and Media Vision's Thunder Board.

Until now, you bought a sound board only if you were serious about music or games. But with Windows 3.1, you'll have a Sound Recorder utility that will let you record a message and embed it into a document in less time than it would take you to type out a note. The only limit on inserting sound into a document is that the receiving application must support OLE as a client.

Once a sound file is stored into such a document, anyone who opens the file will see a microphone icon. If they have a sound device installed, they'll need only to double-click on that icon to hear the recorded sound clip. A PC speaker can be used to play the .WAV files that the Windows 3.1 Sound Recorder will produce, though you'll probably have to ask Microsoft for a copy (the drivers aren't going to be finished in time to ship with 3.1). As you might expect, the PC's speaker generates quality that is too poor for complex sounds, but it's good enough for playing only well-recorded spoken messages. Creating and sharing sound files is simple enough that anyone with even a passing interest in using audio on a PC will have no reason to hesitate. In the coming months, there will be plenty of new applications to make audio even more compelling. Lotus has been working on ways to use sound as an aid to software training.

Windows 3.1 may undermine the more ambitious MPC standard, which has had only halting success. Since Windows 3.1 is compatible with MPC and treats it as a richer set of features, the introduction to sound could result in the eventual success of MPC if users find they want better quality. But MPC still requires more than $500 worth of hardware and has yet to provide a compelling reason to spend the money. It's quite possible that a $100 sound board, some cheap speakers, and Win 3.1 are all the multimedia people want. ■

Gus Venditto is a contributing editor of PC Magazine *and the editor of* PC Sources.

placed into the file.

In the PC world, Microsoft is in an alpha-test phase with a Windows-based solution called AVI (Audio Visual Interleaved), which takes a different approach. AVI creates a single file that contains interleaved audio and video—a block of video, followed by a block of audio, and so forth. The audio and video are synchronized by their proximity. Yet the interleaved approach is flawed, according to Steve Barlow, product manager for multimedia at Lotus. "An interleaved movie with voice and video will break apart when transmitted over a low-bandwidth network, or even when momentarily interrupted by the repositioning of an on-screen window," he says. QuickTime, by contrast, compensates for these things. "It will keep the voice in a movie running smoothly, but drop a few frames of the video in order to keep a presentation intact," says Barlow, who has been experimenting with both technologies.

Although no formal plans have been made for the marketing or licensing of Apple's QuickTime Player for Windows, the company's technology demonstrations have caused quite a stir. And with the Media Control Interface (MCI), Microsoft is ready for QuickTime's imminent arrival. MCI, which will appear in Windows 3.1, acts as a protocol layer between multimedia devices and Windows. MCI was designed to incorporate any new technology, says Hugh Chang, product manager of the multimedia systems group. According to Chang, Microsoft is already testing its Digital Video Command Set, a subset of the MCI that can recognize and control digital video signals. "QuickTime, like Intel's Digital Video Interactive (DVI), is simply another form of digital video that Windows will support," says Chang, who believes users will learn to use the appropriate video format for the appropriate situation.

—*Robin Raskin*

New Ways To Upgrade Software

The last time you upgraded your favorite software package, new floppy disks landed on your desktop. But next time, you may be entering a code to access a compact disk or downloading the files over the phone lines to get the latest features. Several new technologies are enabling creative companies, such as Adobe, to distribute their software in original ways.

Adobe's $99 *Type On Call* for CD-ROM–equipped Macintosh customers is a typeface library with more than 950 PostScript-compatible Type 1 fonts. The fonts are encrypted, however. Users can call up on-screen previews of any given font, but fonts can't be used until they are "unlocked." Access codes for the fonts can be purchased 24 hours a day; prices run about $50 per font. Adobe expects to have a PC version of *Type On Call* but no release date has been set.

Similarly, Monotype Typography's $49.99 *FoneFonts* is a CD-ROM product with 1,450 en-

crypted Type 1 PostScript typefaces (312-855-1440). Users pay for access codes at $45 per font. Currently available only on the Mac, a PC version is planned for April.

Metatec will soon be offering *In an Instant* as a component of its $9.95 Nautilus compact disk monthly "magazine" (614-761-2000). *In an Instant* lets users browse through material such as clip art, software demos, and even music files. If you like what you see—or hear—simply click the purchase button to put the product on a shopping list. When you have everything you want to buy, Nautilus uses an 800 num-

ber to access the host computer, which automatically unlocks the software and images for use. *In an Instant* will be available in late March for the Mac and the PC version will soon follow.

The compact disk isn't the only technology to generate new upgrade ideas. By putting the system BIOS in programmable flash memory, NEC and Zenith Data Systems allow customers to get BIOS upgrades by downloading the new BIOS from a bulletin board, such as CompuServe.—*Eric Berlin*

Modems Get Wireless: RF Vs. Cellular

Wireless modems promise portable computer users the freedom that mobile telephone users have come to enjoy. But the two technologies that are available today—cellular and radio frequency (RF)—are still far from perfect. Cellular technology is widely available but not particularly reliable. RF technology is fairly reliable but not widely available.

Cellular modems work like cellular phones. The modem sends out a signal, which is picked up by the nearest transmission tower and then forwarded. Because cellular phones have been so popular, the towers are ubiquitous. But the connection is just as fragile as it is with a cellular phone, and while a signal drop might annoy you when you're talking on the phone, it will make your modem hang up. And cellular modems require their own software because standard applications depend on a dial tone.

Recently, some vendors have smoothed the cellular connection. The best approaches include products from Millidyne, which provide error-free cellular connections using a proprietary protocol.

Ericsson GE's Mobidem gives HP 95LX Palmtop users wireless two-way communication.

By contrast, RF communications provide stable, robust, and secure connections. But each RF system uses its own vendor-specific transmission service so you can't just bounce the signals off any RF tower to any other. Furthermore, RF stations aren't as prevalent as cellular towers.

Motorola dominates the RF market. IBM and Motorola have collaborated on the ARDIS network for IBM 9075 PCradio computers; Motorola and Racotek recently unveiled the RacoNet MAN (metropolitan area network) service, which will support both voice and data communications. Ericsson GE's Mobidem (available for Hewlett-Packard's HP 95LX) uses packet switching and doesn't require continuous contact with a tower.—*Angela Gunn*

DOS, Windows To Become Network Savvy

Your next desktop operating system could have all the networking you need, which may remove low-end packages like Artisoft's *LANtastic* and *NetWare Lite* from the equation. Low-cost LANs have soared in popularity. Novell says they now account for 20 percent of all network operating system sales. But as Microsoft and Novell build networking services into DOS, Windows, and Unix, the need for separate network packages will die out.

Microsoft plans to add networking features to Windows and Windows NT (its forthcoming 32-bit operating system). And a product that will add *LAN Manager* services to Windows 3.1 is likely.

Novell's strategy is two-tiered. The company recently packaged a *NetWare* shell into DR DOS. Novell is also working with Unix Systems Laboratories to bundle *NetWare* hooks into Unix System V.

As operating systems become network savvy, users stand to gain many benefits. Likely advantages include lower costs, easier installation, more efficient use of resources (memory, for one), lighter administrative duties (upgrading should be easier), and applications that take advantage of the network. —*Mary Kathleen Flynn and David Greenfield*

Low-cost LANs account for one fifth of network operating system sales today, says Novell.

IBM's Router Brings SNA and LAN Together

At long last, IBM, the leading vendor of Token-Ring bridges, has jumped onto the router bandwagon with the 6611 Network Processor. The new product gives network managers an efficient way to integrate SNA and LAN traffic onto a common network, a capability announced previously only by Cisco Systems.

IBM's entry into the router market marks a clear change for the company. In the past, IBM has argued for bridging. Both routers and bridges connect two or more networks together, but routers provide more robust control over network traffic.

One drawback to routers is that they require a network address. However, some protocols, such as Systems Network Architecture (SNA)—the architecture IBM uses to connect different systems—do not have a network address. Vendors such as Wellfleet Communications and Cisco Systems have solved the problem by inserting SNA data inside a protocol packet (like TCP/IP), which provides the network address. But this method requires a central device known as the front-end processor (FEP) to poll devices on the network frequently. The beauty of IBM's 6611 is that, through data-link switching, only the router needs to be polled. Thus, it consumes less network bandwidth and lets more stations attach to a single FEP port.

The 6611 will ship in June and will be able to route Net-

TOP 15 Software Sellers at Retail

RANK	COMPANY
1	Microsoft DOS 5.0 Upgrade Kit — Microsoft Corp.
2	Quicken 5.0 — Intuit
3	WordPerfect 5.1 for DOS — WordPerfect Corp.
4	Turbo Tax Personal 1040 — Chipsoft
5	QEMM-386 6.0 — Quarterdeck Office Systems
6	Microsoft Windows 3.0 — Microsoft Corp.
7	Stacker 2.0 — Stac Electronics Inc.
8	Quicken for Windows — Intuit
9	ProComm Plus 2.0 — Datastorm Technologies
10	Lotus 1-2-3 2.3 — Lotus Development Corp.
11	DR DOS 6.0 — Digital Research Inc.
12	WordPerfect for Windows Trade-Up — WordPerfect Corp.
13	The Norton Utilities 6.01 — Symantec
14	Word for Windows Upgrade 2.0 — Microsoft Corp.
15	LapLink Pro 4.0 — Traveling Software

The list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending February 1, 1992. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market.

Sales information compiled by Ingram-Micro.

BRIEFS

■ **Catching Counterfeiters:** Software developers are growing increasingly aggressive in their pursuit of counterfeiters. Last year, the Software Publishers Association (SPA) took action against 650 companies, more than ever before. In February, investigators from Microsoft helped the State of California Police seize 3,000 bootlegged copies of DOS 5.0 at Entech Computer Inc., a small distributor in Brea. Microsoft says customers should be suspicious of any retail package of DOS 5.0; The MS-DOS 5 Upgrade is the only legitimate version of MS-DOS sold without hardware. To report a suspected counterfeiter, you can call the toll-free antipiracy hot lines at Microsoft (800-NO-COPYN) or the SPA (800-388-PIR8).

■ **Protect Your Privacy:** It may sound like something out of Orwell's *1984*, but Big Brother—or your fiercest competitor—may be eavesdropping on your personal computer. All computers, monitors, and printers transmit data into the air and onto the power lines. Receiving these unwitting transmissions is as easy as bootlegging cable TV, says Hughes STX, a wholly owned subsidiary of Hughes Aircraft Company. To protect yourself, you can do what the government does and buy TEMPEST machines, but they cost up to four times as much as "civilian" systems. Or you can buy a Stealth system from Hughes. Stealth computers, which mask the signals, start at under $2,500 for a 33-MHz 386 (800-423-6807).

■ **Election 1992:** You don't have to turn on the TV or even buy a newspaper to watch the race to the White House. The Prodigy on-line information service recently launched "Political Profile," an interactive database that covers the campaign trail and provides background information on the candidates, including voting records and campaign contributions.
—*Mary Kathleen Flynn*

BIOS, SNA, TCP/IP, IPX, DECNet Phase IV, and XNS protocols. Appletalk will come later. The Model 140 starts at $9,995; the Model 170 at $18,640.
—*David Greenfield*

Operating Systems by Committee

Contrary to popular opinion, operating systems are not created by behemoth totalitarian corporations like the one depicted in Apple's breathtaking "1984" advertisement. Well, not anymore anyway. Both Microsoft and IBM have organized developer relations groups that invite independent software vendors (ISVs) to participate in the design of Windows NT and OS/2. Outside opinions let both companies stay in touch with the realities of what they are trying to accomplish, which is making a robust operating system that ISVs can write to and users will want to buy.

Microsoft calls its forum *Open Process*. It begins at the evangelical stage when company representatives visit primary third-party software developers like Aldus, Borland, Lotus, and WordPerfect to discuss the preview specifications for the operating system design. Ongoing conversations are then continued on an Internet BBS, and eventually final specifications evolve. Those specs can then be used in organized developers' conferences where more ISVs can participate.

IBM began a similar plan under the Developer Assistance Program more than two years ago to get feedback about OS/2 2.0. What the company heard helped it to develop its feature set and add to the Presentation Manager API. And IBM even has an elite group whose sole purpose is to help ISVs write 32-bit programs native to OS/2.

It's not for egalitarian reasons that both companies are so open. The reasons are twofold: First, the stakes are so high that input is needed for acceptance. Second, the competition is fierce and other operating systems like NeXTStep and Solaris threaten to enter the high-end market. The result should be operating systems that benefit not only ISVs, but the customer, who actually pays for them.
—*Christopher Barr*

Floppy Drives: High Capacity, Compatibility

We've been hearing about dramatic boosts in the capacity of 3.5-inch floppy disks for almost two years. Indeed, some drives for disks with capacities of 20MB or more have already shipped, such as Brier Technology's 21MB Flextra. But they cost too much, and they cannot handle old floppy disks, which support lower capacities of 720K, 1.44MB, and 2.88MB. Enter Insite Technology and the new Floptical Association.

Last October, Insite began shipping its 21MB 3.5-inch floppy disk drive to system vendors. The drive uses the new high-density floppy disks, dubbed flopticals, from Maxell and 3M and can also handle the old 3.5-inch floppy disks. External drives should cost between $600 and $700 for end users and are available from Arrow Electronics, Digital Micronics, Grassroots, Liberty Systems, PLI, Procom Technology, Prima Storage Solutions, and Tass Optical World.

Insite's new drive handles both 21MB floppy disks and standard 3.5-inch disks.

To gather support for the new technology, a number of vendors joined forces last year to create the Floptical Association. The organization includes drive maker Insite, media manufacturers 3M and Maxell, and SCSI controller makers Adaptec and Future Domain.—*Oliver Rist*

SPREADSHEETS

CONTINUED FROM PAGE 29

using menu choices, *Quattro Pro for Windows* will require you to build "sensitivity values" into an external dialog box. Connecting the values to the scrollbars lets you cycle through them.

Borland's *Quattro Pro for Windows* will let you cycle through sensitivity values.

Scenario managers are not the only powerful features that will debut in the next crop of spreadsheets. Both Microsoft and Borland are adding seemingly nonessential features that will make working with spreadsheets easier.

Microsoft is adapting "drag-and-drop" features, which are already well implemented in *Word for Windows* and *Excel*. AutoFill, the ability to enter "Jan" and then have "Feb" through "Dec" entered automatically, will be included in *Quattro Pro for Windows* and *Excel*.

Quattro Pro for Windows will also introduce a step up in spreadsheet ease of use: the loose-leaf notebook metaphor. To disguise the complexity of working with 3-D spreadsheets, *Quattro Pro for Windows* will use tabbed pages that can be renamed, moved, and used in formulas. The impression of notebook pages will make it easier to understand which dimension you are working on.

In *Excel* 4.0, AutoFormat will add standardized formatting to any table. This way, your spreadsheets can keep a consistent look.—*Christopher Barr*

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First Looks

Hands-on Reviews of the Latest Products

Speed-Doubling Arrives! $4,999 25-MHz Compaq Deskpro Yields 50-MHz Performance

by Matthew J. Rose

Beginning with its Compaq Deskpro 386, the first Intel 80386-based personal computer, Compaq Computer Corp. has made a habit of being first to market with systems featuring new processors. True to form, Compaq is among the first to deliver a speed-doubled 50-MHz Intel 486 DX2 computer, the Deskpro 50M. The Houston-based PC manufacturer has also pulled its video performance into the nineties with the QVision Graphics System, a brand-new, Compaq-developed accelerated video subsystem with 256-color 1,024-by-768 resolution, and a choice of a 15- or 17-inch multisynchronous display.

A system with 8MB RAM and a 120MB hard disk (not including monitor or DOS) lists for $4,999. Compaq sees the Deskpro 50M as a corporate Windows workstation, unofficially dubbed the "ultimate graphics PC," ready to challenge 33-MHz 486s in price and offering the performance of a 50-MHz 486.

The Deskpro 50M shares the same case and basic design of the entire Deskpro M family. (See First Looks, October 29, 1991, and "486/33: Power Gets Cheaper," February 11, 1992.) Like its siblings, it sports up to 64MB on a high-speed proprietary memory card. Its CPU module is a second proprietary card. There are also five EISA expansion slots (four of which are free) that accept 8- and 16-bit ISA cards or 32-bit EISA cards. One slot comes filled with Compaq's new QVision 1024/E graphics controller, which, when combined with either of Compaq's two new displays, constitutes the company's QVision graphics system. Compaq has also started shipping a 33-MHz 386 modular PC to round out its M line. The Deskpro 386/33M lists for $3,399 with 4MB RAM and a 120MB hard disk.

The speed-doubled Intel 486 DX2 processor operates within a 25-MHz system, yet performs its internal instructions at twice the speed, nearly matching the

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Stanford Graphics Revolutionizes Technical Presentations

HANDS ON by Barry Simon

The presentation graphics market is one of the hottest and most competitive in the software world. Windows programs that come with outliners, slide sorters, and highly visual interfaces that make it easy to create and modify presentations have raised the standards to a new high. Since most presentations consist of word charts, these programs concentrate on working with text and have limited charting abilities.

But what if you're a financial analyst or scientist who needs a heavy-duty charting program that specializes in large data sets and exotic graph types? Until now, you would have needed to pick up a scientific graphing package, typically with a mid-1980s interface and a focus on individual slides rather than an entire presentation. *Stanford Graphics*, the new $495 Microsoft Windows–based package from 3-D Visions, has changed all that.

Stanford Graphics combines the multislide metaphor (with speaker's notes, audience handouts, and slide sorter) with Windows-based font and color support and the powerful graphing and analysis tools that were already in 3-D Visions' *Graftool*, an Editors' Choice winner in our last roundup of technical charting software. (See "Picturing Your Numbers: 12 Technical Graphics Packages, March 26, 1991.) It wraps all this in a brilliantly conceived interface to make a program with wide appeal.

The first version, however, is unstable and plagued with Unrecoverable Application Errors (UAEs) as well as less insidious bugs, which 3-D Visions is committed to fixing. For now, though, the program is so powerful that many users may opt to purchase the first version as paying "beta testers" of sorts while the wrinkles are ironed out.

2-D AND 3-D CHARTS: BIG SELECTION, MORE OPTIONS

Central to *Stanford Graphics*' design is its ability to draw graphs and analyze data. Its charting gallery comes with a whopping 163 chart types divided into six categories: business, statistical, and technical, with each category split into 2-D and 3-D types. Many of these charts are variants of each other, but the num-

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Compaq

CONTINUED FROM PAGE 37

performance of a 50-MHz 80486DX chip. (For more information on Intel's speed-doubling DX2 technology, see Trends, February 25, 1992.) Compaq has loaded a 256K external cache onto its CPU module in addition to the 8K cache internal to the DX2 chip.

PC Magazine Labs' tests showed that the Deskpro 50M performs on a par with straight 50-MHz 486-based PCs. Of the 16 50-MHz 486s tested in PC Labs to date, the Deskpro 50M ranked ninth in processor performance, although its memory performance ranked thirteenth. This is the result of Compaq using 80-nanosecond DRAM chips, while machines that operate at 50 MHz tend to use faster 60- or 70-ns. memory chips.

The bottom line: The Deskpro 50M brings you close to 50-MHz performance at a far lower price (the Deskpro 50L is priced at $11,499). And since Compaq intends to offer a 50M CPU module to current Deskpro M owners, this makes for a compelling CPU upgrade option.

VIDEO FOR TODAY'S MARKET

The QVision system is the second half of the story from Compaq. With graphics now capable of displaying 1,024-by-768 resolution with 256 simultaneous colors (or a photorealistic 65,000 colors from a palette of 16.7 million at 640-by-480 and 800-by-600 resolutions), Compaq's video has finally reached—and surpassed—Super VGA level.

Compaq had altered its existing VGA circuitry to accommodate 800-by-600 resolution when it introduced the Deskpro M family last October, but only at 16 colors. Now, Compaq has gotten back into step with the industry, offering a graphics system to meet the demands of its customers. Better still, it is offering high-resolution monitors so that Compaq users no longer need to purchase monitors from a second source.

Rounding out the QVision graphics system are two multisynchronous noninterlaced displays: the 15-inch QVision 150 and the 17-inch QVision 170 color monitors, manufactured by Zenith. While Compaq could not provide us with a 15-inch unit, the QVision 170 features a flat panel display and front-panel controls managed by an internal microprocessor that remembers user settings. The display holds eight preset factory settings; six more can be determined by the user. A 0.25 dot pitch and 70-Hz refresh rate should ensure crisp, low-flicker output.

We stacked the performance of Compaq's "ultimate graphics PC" against our Editors' Choice–winning Portacom Eclipse II and ATI Technologies' Graphics Ultra adapters. Compaq's performance greatly exceeded the two other graphics accelerators, for two reasons.

First, Compaq has included several graphics functions and primitives used frequently by Windows and other GUI environments. When Compaq introduced its advanced VGA with the Systempro two years ago, it incorporated a BitBlt (bit block transfer) engine in the VGA circuitry to improve video performance dramatically, and hardware graphics acceleration began. With its new QVision design, Compaq has added a hardware cursor and a line-draw engine to further offload graphics functions from the CPU. This translates to faster performance.

Second, since the CPU is also crunching instructions at a speed-doubled 50 MHz, video performance receives a welcome boost. Compaq will offer its QVision 1024 controller as a video upgrade in both EISA and ISA versions for $599, but we were not able to test the board in a slower PC. The ATI and Portacom boards were tested in the Compaq Deskpro 25e, a 25-MHz 386, but we tested the Graphics Ultra in a 33-MHz 486, and its performance closely approaches that of Compaq's.

Nevertheless, the QVision video is blazingly fast, on a par with today's best third-party graphics boards.

With its impressive processing power, moderate price, and improved graphics, the Deskpro 50M should prove itself worthy of any desktop computing challenge. And when it no longer can, there will probably be a new upgrade path. ■

List Price: Compaq Deskpro 50M, with 8MB RAM, 3.5-inch floppy disk drive, QVision 1024/E Controller, $4,399. DOS 5.0, $99; Model 120, $4,999; Model 340, $6,199. **List Price:** Compaq Deskpro 386/33M, Model 1, $2,799; Model 60, $3,099; Model 120, $3,399. **List Price:** QVision 150 (15-inch) color monitor, $899; QVision 170 (17-inch), $1,299. **List Price:** QVision 1024/E (EISA) or 1024/I (ISA) controllers, $599 each. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-231-0900.

CIRCLE 432 ON READER SERVICE CARD

BENCHMARK TESTS: COMPAQ DESKPRO 50M

For all intents and purposes, the 50-MHz Intel 486DX2, with its speed-doubling technology, performs just like a standard 50-MHz 486 CPU on PC Labs' processor and memory tests. Compaq's outstanding new video circuitry also shines, as the Deskpro 50M easily outperforms its sibling Deskpro 50L and the Dell PowerLine 450DE on our video hardware tests.

HOW WE TESTED

Version 6.0 of PC Magazine Labs' Hardware Performance tests measures the number of operations performed or the data throughput over a period of time. As a result, a larger number means better performance. For a complete description of the individual tests, please refer to "High-End Notebook PCs" (page 154 of this issue).

Higher scores represent better performance	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)
Compaq Deskpro 486/50L	528.54	9,903 32	252.35	3,588 22
Compaq Deskpro 50M	523 51	7,688 61	381.24	5,922.13
Dell PowerLine 450DE	520 62	8,253.13	335.10	4,416.85

WINDOWS BENCHMARK TESTS

We compared Compaq's new QVision video subsystem against the Editors' Choice–winning Portacom Eclipse II and ATI's Graphics Ultra. While Compaq's numbers are impressive, the additional horsepower of its clock-doubled 50-MHz Intel 486 DX2 processor contributes much to Compaq's overall video performance.

HOW WE TESTED

We perform all graphics adapter tests using Windows 3.0 in 386 Enhanced mode on a Compaq Deskpro 386/25e with 8MB RAM, running at 800- by 600-pixel resolution with 256 colors and a screen refresh rate of 72 Hz. However, since the Compaq Deskpro 50M features a 50-MHz speed-doubling Intel 486 DX2 and an EISA-based video adapter card, its performance numbers are not directly comparable to the other cards listed here.

The **Memory-to-Screen BitBlt** test moves a 64- by 64-pixel bitmapped image of the *PC Magazine* logo from system memory to screen memory (**Source Copy**); it then moves the resulting bitmap displayed on-screen from system memory to screen memory (**Pattern Copy**).

The **Draw Horizontal** and **Draw Diagonal Lines** tests use the Windows 3.0 LineTo function to draw lines on-screen. Line drawing is used for borders around Windows and for many other lines you see on the screen.

The **Random Rectangles** test measures the time it takes to draw and fill a series of rectangles with various patterns of dithered colors. Windows uses such patterns to fill in many areas of the screen, especially when a graphics adapter can display only a limited number of colors.

Throughput (thousands of pixels per second) Higher scores represent better performance	Memory-to-Screen BitBlt Source Copy	Pattern Copy	Draw Horizontal Lines	Draw Diagonal Lines	Random Rectangles
Compaq Deskpro 50M	5,254 36	15,119.25	9,578 82	5,865 13	26,870.36
ATI Graphics Ultra	1,675 65	5,147.35	3,591 66	3,801.20	17,948.54
Portacom Eclipse II	1,595 50	5,138.12	3,960.10	3,913 27	7,845.67

Stanford Graphics

CONTINUED FROM PAGE 37

ber of base types is still impressive.

The 2-D business charts include not only the ubiquitous area, bar, pie, and line charts but also spider, bubble, and Gantt charts. The statistical charts include star plot and box-whisker as well as histograms and scatterplots. The 3-D technical plots include surface, linked surface/contour, trajectory, and vector plots.

Chart types can be configured in numerous ways by selecting an element and double-clicking. The resulting dialog box lets you adjust all the standard elements—tick marks, units, colors, and labels—but usually with more options than other programs offer. For example, in addition to linear and logarithmic scales, there is a probabilistic scale.

There's also a wonderful set of graphics controls you can use to adjust the viewpoint of a 3-D plot. You can even rotate a wireframe image in real time.

Stanford Graphics has a built-in spreadsheet so you can enter or import data or cold-link via dynamic data exchange (DDE) to Windows spreadsheets or to disk files in several formats. The program can also import *Graftool* data and chart files.

ANALYTICAL TOOLS: SMART DATA CURSOR

Once the data is in the spreadsheet and displayed, *Stanford Graphics* provides a variety of analytical tools. You can call up the "intelligent data cursor" for any graphed data. Just point this cursor at a graph and the values corresponding to the point in question will be displayed.

In addition to basic statistics, *Stanford Graphics* offers several varieties of curve fits. Once the fitting is done, you can call up a graphical gadget called a "data equalizer," which has one lever for each free parameter in the fit. By moving the levers, you can adjust the parameters and see the fitted curve change before your eyes. This will let you find alternate fittings if the program's best fit isn't ideal.

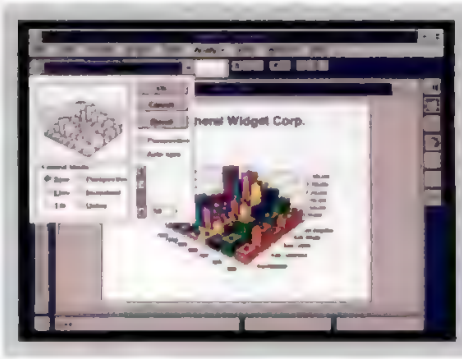
For any object that has options, *Stanford Graphics* gives you a lot to choose from. There are 12 bullets for bulleted text, 20 fill patterns, and 15 data symbols to indicate points in *x,y* plots. The program supports all Windows fonts and works fine with *Adobe Type Manager*.

BASIC DRAWING TOOLS

Stanford Graphics provides rudimentary drawing tools including arrows, squares, and Bezier curves. You can temporarily group objects and move them, but you cannot make permanent groups.

There's no bundled clip art, but you can import clip art in a variety of formats (including .DRW, .GIF, Lotus .PIC, .PCX, and TIFF) for placement on slides. The program's ability to import vector-based graphics is quite good, but its inability to break apart vector groups will limit the use of complicated clip-art files. Bitmapped import filters are all disappointing, with limited color support and graininess on gray-scale imports.

You can manipulate the color of almost any object through a common dialog box and can apply linear, diagonal, and radial gradients to many objects. On-screen gradients, however, will have a rather grainy appearance.



Stanford Graphics' toolbox lets you rotate 3-D graphs. There are 163 graph types, from business and statistical graphs to exotic types like box-whiskers.

Stanford Graphics' text handling is a mixed bag. On the positive side, you can pop-up visual keyboards with scientific symbols or Greek letters and assign different bullet types to different levels of the presentation. There's also a miniruler to set tabs and justification, but you cannot set a font and size for each level of text. Even worse, when you want to make modifications, a dialog box presents you with defaults rather than the font information you may have selected previously.

There's a well-crafted slide sorter as well as options to make thumbnail audience handouts and speaker's notes. There is an outliner but it is quite primitive, showing only the main title for slides with bulleted text.

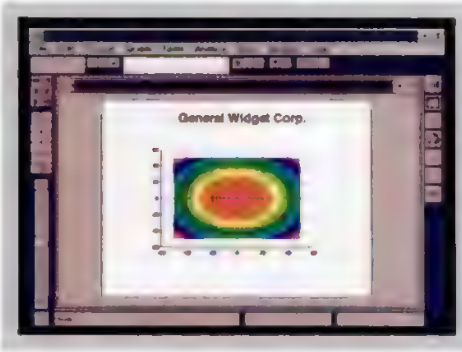
Slow printing, one of *Graftool*'s biggest weaknesses, has been addressed in *Stanford Graphics*. On informal tests, simple graphs printed on an HP LaserJet III in about 1 minute; complex graphs printed in no more than 5 minutes. While it's no speed demon, performance is certainly acceptable and the quality of the output is superb.

Stanford Graphics' user interface is unique and pleasant. At first, the plethora of buttons surrounding the central work area—36 in all—may make you wince. But because of intelligent grouping, the interface works and becomes easy to use.

The documentation that comes with the program is rather poor, with an almost useless index and a reference manual organized by menu item. There's not much in the way of a user's guide. The first version has no on-line help, but it's promised soon.

During testing, we encountered enough UAEs that they became a real concern. The audience handout button caused repeated UAEs, as did certain file imports. The font dialog box crashed about a third of the time it was invoked. Hitting Delete in outline view also caused UAEs. The core graphing and analysis routines seemed much more stable. There were also some smaller bugs, such as bullets, that tended to disappear.

Stanford Graphics has an extremely ambitious and well-integrated design. By combining the full-presentation gestalt of Windows-based presentation graphics programs with the detailed technical charting and analysis of technical graphing packages, it is the first true technical presentation package. Once the initial rough spots are ironed out, it will be the presentation program of choice for anyone with large data sets. ■



You can create color-coded contours with *Stanford Graphics*. Objects can also have linear, diagonal, and radial gradients.

FACT FILE

Stanford Graphics for Windows
3-D Visions, 2780 Skypark Dr., Torrance, CA 90505; 800-729-4723, 310-325-1339.
List Price: $495.
Requires: 2MB RAM, 6MB hard disk space, Microsoft Windows 3.0 or later. Mouse and math coprocessor recommended
In Short: A revolutionary product that combines the sophistication of a scientific charting package with the elegance of modern presentation graphics packages to make the ideal package for anyone giving presentations with lots of technical data. The first release, however, is marred by UAEs and bugs.

CIRCLE 426 READER SERVICE CARD

Ventura 4.0 Lets You Add Color—But How Good Is It In Black and White?

HANDS ON

Ventura Publisher Windows Edition reaches Version 4.0 with an upgrade that adds color capabilities and editing tools like search-and-replace, spell-checking, and Undo, but the most important new feature in Ventura Software's $795 desktop publishing package doesn't come in the box. Ventura now lets you extend its graphics support with one or more extension programs: the $495 *Ventura Separator* (for advanced color separations within *Ventura*), the $295 *Ventura Scan* (which lets you run a color scanner within *Ventura*), the $895 *Ventura PhotoTouch* (for standalone or *Ventura*-integrated retouching), and the $895 *Ventura ColorPro* (for standalone or integrated color correction and separation).

These extension products (not yet released) promise to be major additions to *Ventura*'s capabilities. Version 4.0 offers a mix of improvements and disappointments that make it a significant upgrade, but the improvements still won't eliminate users' complaints about *Ventura*'s awkward interface, steep learning curve, lack of macros, and inability to handle more than one document at a time.

Ventura lets you see pages in reduced, normal, and enlarged views but does not allow an infinite zoom. The Paragraph menu gives an overview of the typographic controls.

24-BIT COLOR

Ventura's new graphics features include support for 24-bit color TIFF, a palette of 16.7 million colors with 253 colors per document, and support for color definition using CMYK, CMY, HLS, Pantone, and RGB color models. Custom colors can be set and saved easily. You can print color separations directly from *Ventura* without an add-on, but for color correction and other adjustments you will need an add-on such as *Ventura Separator* or *ColorPro*.

Through Windows' object linking and embedding protocol (OLE) you can import and update objects like *Microsoft Excel* charts and graphics from other applications that support OLE. You can't maintain OLE links to text files without losing a lot of *Ventura*'s control over formatting. Nor can you import objects from server-only "embedded" applications like the equation editor that ships with *Microsoft Word for Windows*—which can be used by other OLE-aware applications such as *Ami Pro*.

INTEGRATED TEXT TOOLS

Ventura's new search and spell-checking features, unlike corresponding features in *PageMaker* 4.0, are integrated into the program and don't require you to open a separate story editor. Spell-checking is fast and effective, but as with many *Ventura* features, its menu arbitrarily lets you use keyboard shortcuts for some options but not others. You can skip or replace a word with a keyboard shortcut, but you have to use the mouse or do a drum-roll on the Tab key to reach the checkbox that adds a word to the personal dictionary. You can't resume an interrupted spell-check halfway through a document.

The search-and-replace menu lets you search for text, attributes, or format tags, but you can't search for wildcards. The new single-level Undo feature has the short memory typical of the similar function in most Windows applications, and it doesn't work with many graphics operations. Fifty new sample stylesheets help design a page.

Compared with Version 3.0, which despite its name was the first Windows version of *Ventura*, the new version is significantly faster and seems more reliable, but it's still no speed demon when loading or manipulating fonts. On a 33-MHz 486 system with over 100 PostScript fonts installed, Version 3.0 took 3 minutes 7 seconds to load and create a width table for the current Windows environment. Version 4.0 takes a still-excruciating 2 minutes 2 seconds.

Once the new width table was renamed and associated with a stylesheet, the old version needed 88 seconds to load, the new one 53 seconds. Using fewer fonts speeds loading considerably. Printing, especially using PostScript printers, is notably faster than before.

You can import files from most major word processors, including *Word for Windows* 2.0, but *Ventura* ignores stylesheets used by imported formats. The manual describes a feature that lets you wrap text around irregular graphics, but as the last-minute release notes explain, the feature wasn't ready when the software shipped. Oddly, a blank line remains on the Frame menu where the Text Wrap feature was supposed to be.

Ventura violates many standard Windows conventions, sometimes to its advantage. Unlike most Windows applications, it knows if you have access to an italic or bold version of a font, instead of putting nonprinting italics or boldface on your screen by simply slanting or thickening the roman version. It sensibly ignores the Windows norm that causes a selected block to be replaced by the next keystroke. But it less sensibly uses Del and Ins to move text in and out of the Clipboard, and its keyboard lacks shortcuts you take for granted in other Windows programs.

GREAT FOR COMPLEX DOCUMENTS

Like Version 3.0, *Ventura* 4.0 still surpasses *PageMaker* at preparing complex documents with standardized formats and complex cross-references. Its stylesheets allow unmatched typographic flexibility; its text variables let you change the name of a product in a huge technical manual without the tedium of a search-and-replace. Its use of ASCII files lets you alter your text with a fast word processor, and its integrated table editor is easier to work with than *PageMaker*'s separate module.

PageMaker, however, surpasses *Ventura* in ease of use for small and design-intensive publications, and probably remains the best choice for anything smaller than the giant projects at which *Ventura* excels. Neither *PageMaker* nor *Ventura* lets you open more than one document at a time—a feature promised in *FrameMaker for Windows*, due in mid-1992.

Ventura's new version won't make you throw away your word processor, but new features eliminate many of its annoyances, and it's now ready for any color printer or scanner you own. For high-pressure document production, especially on corporate networks, nothing else comes close. ■

PC FACT FILE

***Ventura Publisher Windows Edition*, Version 4.0**
Ventura Software Inc., 15175 Innovation Dr., San Diego, CA 92128; 800-822-8221; 619-673-0172.
List Price: $795.
Requires: 4MB RAM, 20MB hard disk space, Windows 3.0 or later.
In Short: *Ventura* adds an integrated spell-checker and search-and-replace, but its most important feature is its ability to work with add-ons for color separations, scanning, and image processing.

CIRCLE 429 ON READER SERVICE CARD

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CIRCLE 259 ON READER SERVICE CARD

Picture Publisher 3.0: A Rich Set of Tools for 24-Bit-Color Image Editing

HANDS-ON
By Barry Simon

In the era of Windows 2.0, Astral's *Picture Publisher* was a leader in bitmapped image editing on the PC. After Windows 3.0 opened up the realm of 24-bit color, a number of vendors—notably ZSoft with *Publisher's Paintbrush* and *PhotoFinish* and Aldus with *PhotoStyler*—moved to take advantage of the new environment. Micrografx's *Picture Publisher* 3.0 has been slower to arrive, partly because of Micrografx's acquisition of Astral. The $795 image editor may be late to the competition, but it's the best competitor out there.

Strong in all areas of image processing, *Picture Publisher* is especially notable for its selection and masking tools and its accessible interface. The program's only serious weakness is that it's sometimes slow.

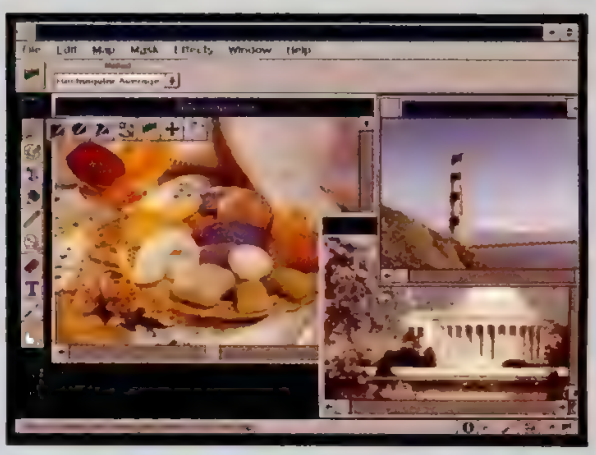
The interface is an extension of the one used in Micrografx's *Windows Draw*, an interface likely to become the new standard for Micrografx applications when new versions of *Designer* and *Charisma* appear. Down the left side of the screen is a button bar of top-level choices: masking, retouching tools, filters, fill tools, drawing tools, a magnifier, an eraser, a text tool, and a color probe. Press one of the first five, and a horizontal button-bar pops out. For example, the fill tool lets you choose among gradient, tile, solid tint, and smart fills.

Once you've picked the currently active tool, a ribbon displays that tool's controls. For example, if you pick the tile fill, the ribbon displays a drop-down list of tiles, buttons to flip the tile horizontally or vertically, and a spin control to determine transparency. This interface provides quick and clear access to a huge array of functions.

RETOUCH PHOTOS

Many photo-retouch operations depend on the ability to select and/or mask an area of a picture. With *Picture Publisher*, you can mask either the inside or outside of the selection. The masked area is not affected by the other tools you choose to apply.

Among current Windows image-editing programs, *Picture Publisher* is unique in allowing you to edit the curve defining the mask. When you edit in Mask mode, you can add, delete, or move the nodes defining the curve.



Picture Publisher's masking tools let you work on one part of an image without affecting another part.

Also unique is its ability to designate one or several colors that will not be overlaid, a feature it calls Color Shield.

Like *PhotoStyler*, *PhotoFinish*, and Image-In's *Image-In Color*, *Picture Publisher* has a magic wand that automatically selects a boundary by sensing color changes. But *Picture Publisher*'s magic extends further. While drawing a freehand selection region, you can turn on Smart-mode. The tool then attempts to draw the curve between clicks using color changes. Similarly, one of the fill tools tries to use color changes to bound the filled region. And when the magic isn't quite right, the ability to edit the bounding curve is invaluable.

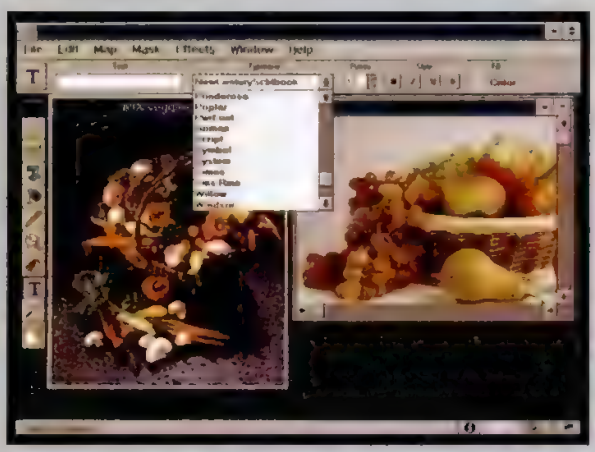
OPEN MULTIPLE VIEWS

Picture Publisher's multiple document interface (MDI) allows editing of several images at once. Its handling of multiple views of a single image is almost as good as that of the ZSoft products, which were in a class by themselves until now. You can open multiple views of one picture and either link them to show changes in all windows or unlink them to keep an unedited version in view. It falls short of the ZSoft products in that it doesn't let you use a normal-size view to move around the viewpoint shown in the blown-up view.

Picture Publisher has all the other tools you'd expect in a high-end image editing program: Windows font support, a wide array of filters, and support for transparency and feathering. It has a clone tool to duplicate a pattern from one part of a picture to another part. It supports many gray scale and color scanners, and through June 30 comes bundled with a Mustek M-6000CG Color Artist 18-bit color hand scanner that lists for $699. For now, scanner support does not include automated stitching.

The program has lots of thoughtful extras. Icons of minimized images are thumbnail views, and the program keeps separate directories for file types: .BMP, .GIF, .PCX, TIFF, and so on.

The one weak spot in this superb program is speed. It's not glacial, but you'll drink a lot of coffee while it does its stuff. Particularly slow is the loading of .PCX files, which can take up several minutes. But for now, *Picture Publisher*'s rich features make it the high-end image-editing product of choice. ■



The text handling in *Picture Publisher* supports any available Windows font.

FACT FILE

***Picture Publisher*, Version 3.0**
Micrografx Corp., 1303 Arapaho, Richardson, TX 75081; 800-733-3729, 214-234-1769.
List Price: $795.
Requires: 4MB RAM, 1.5MB hard disk space, Microsoft Windows 3.0 or later.
In Short: A superb image-editing program, particularly strong in image masking and the ability to protect overwriting of selected colors.

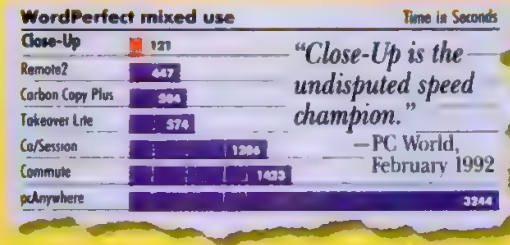
CIRCLE 422 ON READER SERVICE CARD

Close-Up Wins Remote Honors

PC WORLD

Close-Up is fast, easy to use, and reliable. What else do you need in a remote package?

Close-Up Dual Pack 4.0 earns its Best Buy by virtue of lightning speed, an easy interface, reliable error handling, and a complete set of tools for controlling one computer from another and collaborating with a partner. It's also the only package that can run Windows reliably from afar—even in extended mode. Runner-up **Remote2** isn't quite as fast, and its toolbox is smaller, but it is perfectly dependable with graphics.



"Close-Up is the undisputed speed champion."
—PC World, February 1992

Excellent ★★★★
Good ★★★
Fair ★★
Poor ★

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Carbon Copy Plus 6.0	671	★★½	★★½	★★	★★★½	★★½	★★	★★★½	★★½
Central Point Commute 1.1	673	★½	★½	★★	★★	★★	½	★★★★	★★
Close-Up Dual Pack 4.0	672	★★★★	★★★★	★★★★	★★★★	★★	★★★	★★★★	★★★★
CO/Session 6.0	674	★★★½	★★½	★½	★★	★★★½	★½	★★★½	★★½
pcAnywhere 4.03c	675	½	★★	★½	★★★★	★★	★	★★★½	★½
Remote2 2.1	676	★★★	★★★★	★★½	★★½	★★★½	★★½	★★★½	★★★
Takeover Lite 2.0	677	★½	★½	★★	★★★	★★★	★★★	★★★½	★★

Overall value is calculated by multiplying each category rating by the category's weight percentage, summing the results, and rounding to the nearest half number.

Actual test results reprinted from PC World's Review of Remote Communications Software, February 1992.

Now Supports Both Windows & DOS

Remote Performance: Why Close-Up is Best

- *Supports both Windows and DOS with the same program.*
- *Fastest VGA, EGA and CGA graphics.*
- *Fastest file transfers and remote screens.*
- *Runs Windows in all 3 modes. No restrictions.*
- *Runs multiple Windows and DOS applications simultaneously, full-screen or windowed.*
- *Remote mouse and keyboard control.*
- *Self-installing, fully-automated for fast, easy operation.*

Call for FREE Working Model

"Close-Up...The Best Program You Can Buy for Remote Control"

—Reprinted from PC Magazine, January 14, 1992

The Ultimate Remote Program

"Norton-Lambert's Close-Up is the fastest, easiest, and the most reliable program we looked at..." —PC World, February 1992

The results are in and the experts agree. New Close-Up 4.0 has proven time and again to be the most advanced remote control system available.

Close-Up lets you view & control PCs miles away *by modem*. Now with full support for Windows, DOS, graphics and mice at record-breaking speeds, Close-Up is the fastest, easiest way to handle all your remote communications needs.

What You Can Do:

- ✔ Take control of PCs at any location.
- ✔ Work remotely on the road via laptop.
- ✔ Control your office PC from home.
- ✔ Access your company's branch offices.
- ✔ Train your associates on any application.
- ✔ Help customers miles away, remotely.
- ✔ Transfer text, data, any file between PCs.
- ✔ Remotely install and run Windows.
- ✔ Automate remote operations at night.
- ✔ Access networks all over the world.

PC MAGAZINE	PC WORLD BEST BUY	LAN TIMES RECOMMENDED NETWORKING	PC MAGAZINE EDITORS' CHOICE
January 1992	February 1992	November 1991	February 1992

Winner of the Top Awards

"Close-Up has been highly polished and it's flexibility and capability clearly make it the best program you can buy for remote control."
—PC Magazine "Best of 1991," January 14, 1992

"If you're serious about going remote, check out Close-Up. The program's handling of Windows is simply dazzling."
—PC World "Best Buy," February 1992

"Close-Up is one of the fastest products we've seen. It had the fastest file transfer times and the shortest times redrawing the screens."
—LAN Times, November 18, 1991

"You will not find a better all-around remote-control program."
—PC Magazine "Editors' Choice," February 25, 1992

Control both Windows and DOS with just one program

Now with double the remote power, Close-Up gives you full support of *both* Windows and DOS. That's like getting two remote programs for the price of one!

Spectacular Savings!

Now you can receive the Close-Up 4.0 Dual Pack including both sides for only $199—you save $240!

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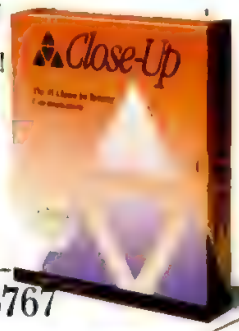

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CIRCLE 028 ON READER SERVICE CARD

Toshiba's T3300SL: Great Design Meets Battery-Saving Smarts

HANDS ON
by Sal Ricciardi

Given all the hype surrounding the power-saving talents of Intel's 386SL processor, you might expect the $3,999 T3300SL, Toshiba's first 386SL notebook, to run forever off a single battery charge. The truth is, when you're pounding away at the keyboard, the 386SL offers little more than a faster processing rate over a 386SX. It's when you step away from the keyboard that the SL's special power-management features have the opportunity to earn their keep.

The notebook is built around a 25-MHz 386SL and weighs 5.9 pounds including the 1.2-pound nickel-hydride battery. Standard equipment includes a 64K static RAM cache, 2MB of 70-nanosecond RAM, and a 2.5-inch 80-megabyte hard disk that has a 16-millisecond access time.

The T3300SL also has one serial and one parallel port, a PS/2-style mouse port, a connector for an external VGA monitor, a port for attaching an optional numeric keypad (or, with an extra-cost adapter, an external 101-key keyboard), and an expansion port connector for Toshiba's Desk Station IV.

A custom clip for the Microsoft BallPoint mouse, DOS 5.0, and hypertext on-line documentation round out the systems's standard lineup.

The T3300SL's CPU Super Sleep mode saves system power by slowing down processing to 6.25 MHz, 3.125 MHz, or if the CPU is completely idle, to 0 Mhz. It's the 386SL's static design that lets it retain information while slowing down this much.

You can turn off power to the hard disk and display sidelight after a specified period of inactivity, and you can turn off power to the optional $449 2,400-bps credit card–style modem when you're not using it. The modem card slides into a PCMCIA-compatible slot that can be used for other compatible devices when they are available. The FDD Auto Off option uses the SL chip set's I/O trap feature to let you stop the power to the floppy disk drive, saving battery power.

You can reduce the amount of power used by the sidelit LCD screen by choosing a Semi-Bright mode, which dims the display slightly but still provides enough contrast for many applications.

Toshiba's AutoResume mode lets you shut off your computer without properly exiting your application and resume exactly where you left off at a later time. This can be a terrific convenience if you need to shut down quickly. It can also be a lifesaver, since AutoResume kicks in if your battery dies while you're working.

The $3,999 Toshiba T3300SL weighs just under 6 pounds and has sophisticated power management features.

While this feature has long been standard on Toshiba machines, the 386SL makes it easier for Toshiba to implement. For example, where models such as the T2200SX require a software fix in order to resume a Windows application, the T3300SL requires no such driver. We had no problem shutting off the T3300SL in the middle of a Windows application and resuming later.

Two other features work in conjunction with Resume mode. You can enable System Auto Off to shut off power to the computer after 30 or 60 minutes of inactivity. And you can enable Panel Power, which automatically shuts off power to the machine when you close the display panel. Then, when you open the panel, the system turns itself on and resumes where you left off. There's also an Alarm Power option that lets you specify a time for the computer to automatically power-on.

All of these options can be set through the disk-based setup program. The setup program also lets you register a system password that you'll have to enter whenever you power-up the machine.

The T3300SL uses Flash ROM, which means updating the BIOS is a simple matter of inserting an update disk and running the ROM update program.

The unit's display is the same as that found in the Toshiba T4400SX, a 9.5-inch fluorescent sidelit LCD with adjustable brightness and contrast control. In standard VGA mode, the unit maps colors into 16 gray scales. Thirty-two gray scales are available at 320-by-200 resolution. The display is bright and clear, especially in graphics mode when running Microsoft Windows. In text mode, it seemed a little washed-out and required a lot of adjusting.

In PC Magazine Labs' Battery Rundown test, the T3300SL averaged close to 3 hours of continuous use with all battery conservation features disabled. This is approximately 30 minutes less than a T2200SX (which uses a different screen) but better than the similarly priced Compaq, Dell (with color display), and Zenith Data Systems 386SL notebooks we recently reviewed (First Looks, March 31, 1992).

On our benchmark tests, the T3300SL proved a strong contender, equaling the current SL field in processor, memory, and disk performance.

All things considered, the T3300SL offers a fine combination of speed, portability, and battery life. ■

BENCHMARK TESTS: TOSHIBA T3300SL

PC LABS

Toshiba's T3300SL is on a par performance-wise with the current crop of SL notebooks with one exception: Neither Toshiba nor Zenith Data Systems can match the video performance achieved by Compaq with its LTE Lite/25.

HOW WE TESTED

The test results reported here are taken from Version 6.0 of PC Magazine Labs' Hardware Performance Tests. The tests in Version 6.0 measure the number of operations performed or the data throughput over a period of time. As a result, a larger number means better performance. For a complete description of the individual tests, please refer to "High-End Notebook PCs" (page 154 of this issue).

Higher scores represent better performance	Processor (operations per second)	Memory (kilobytes per second)	Disk (kilobytes per second)	Video (thousands of operations per second)
Compaq LTE Lite/25	129.04	2,735.41	155.02	3,030.36
Toshiba T3300SL	127.65	2,736.10	153.75	1,206.30
ZDS MastersPort 386SLe	127.48	2,593.70	152.33	1,356.60

FACT FILE

PC MAGAZINE

Toshiba T3300SL
Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-457-7777; 714-583-3000
List Price: With 2MB RAM, 80MB hard disk, 1.44MB floppy disk drive, DOS 5.0, $3,999; with 120MB hard disk, $4,499. Memory cards: 2MB, $435; 4MB, $699; 6MB, $999. 2,400-bps internal modem, $459.
In Short: The T3300SL is solidly built, weighs only 5.9 pounds, gets 3 hours of battery life, and has an excellent keyboard.

CIRCLE 431 ON READER SERVICE CARD

"The Best Memory Manager"

It's an easy claim to make, but we have the facts to back it up:

Our new QEMM-386 version 6 is the best way to get the most out of memory. It 'pools' all your memory so that it's available in whatever form your programs need—expanded or extended. You don't even need to know the difference. QEMM does it all for you. Instantly. Whereas DOS 5, for example, requires you to figure out what you need, then manually allocate memory and re-boot every time you need to change.

> "It's nothing less than a dream come true"
> —*Steve Gibson InfoWorld 8/26/91*

As for the all-important 'conventional' memory area, our new version 6 increases the amount of memory freed-up. Our exclusive 'optimize' feature automatically seeks out TSRs and device drivers and moves them into high memory—the area between 640K and 1 megabyte. All you need do is type 'OPTIMIZE'.

PC Week rated QEMM 6 the best memory manager.

Our latest awards.

QEMM-386 v6 finds more high memory than any other memory manager. *Byte Magazine's* tests showed it produced net memory gains of 21K to 132K over DOS 5.0 alone, for instance.

Stealth takes you to network and TSR heaven.

Our breakthrough 'Stealth' technology makes available areas normally taken up by ROM. Areas that QEMM-386 can use to load memory-hogging drivers and TSRs. Big programs can get the memory they need to run fast and efficiently. And you get to have your TSRs.

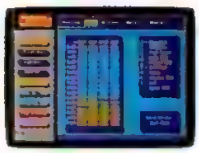
Not every PC can benefit from Stealth. But every PC can benefit from 'Squeeze'—our new feature to accommodate those TSRs that need more memory at start up and less when they're resident. Memory allocation is temporarily increased, then squeezed down after it's needed.

QEMM is not only the best selling memory manager, it's the number one selling PC utility.

QEMM can use idle video memory to produce a further 96K gain on EGA and VGA systems when running character-based programs.

A priceless $60 bonus.

QEMM comes with Quarterdeck Manifest, the award-winning analysis program that shows what's going on 'under the hood' of your PC.



Manifest does for memory what PC Tools Deluxe does for disks.

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Whether you're running DOS 3, 4, 5, or Windows, QEMM can improve your 386/486's performance.

That means you may not need a faster CPU. You may not even need more RAM. QEMM makes your favorite programs work better by giving them more memory.

QEMM helps you get the most out of the software you own today.

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Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire, Co. Dublin, Ireland Tel. (353) (1) 288-1444 Fax: (353) (1) 284-4380

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Key to comparison table: Software compatibility is defined as the product's ability to run without problems with the operating systems PC Week Labs used in testing, MS-DOS 5.0, IBM PC DOS 5.0 and Microsoft Windows 3.0, and with a variety of application software, including Quarterdeck's DESQview 2.40, Xerox Ventura Publisher 3.0 for DOS, WordPerfect 5.1 and Artisoft's LANtastic 4.0. Hardware compatibility is defined as the programs's ability to run on PC Week Lab's test hardware platform, which included a 33MHz 486-based PC and a 25MHz 386-based IBM PS/2 Model 70. Reliability ratings are based on the successful and dependable performance of each operating system and application-software package under each memory manager. Ease of use is based on ease of installing and configuring each program, based on support for automatic loading features and the intuitive nature of the interface. Flexibility in managing memory is rated on the range and quality of the product's features in optimizing system performance and handling special-case installation. Quality of documentation is judged by the clarity, comprehensiveness and helpfulness of the documentation provided with the product, based on the organization of the manuals as well as the thoroughness of definitions, directions and explanations, and the inclusion of troubleshooting information.

CIRCLE 336 ON READER SERVICE CARD

pcAnywhere, Now from Norton, Offers Windows Remote-Control Computing

HANDS ON
by Carol Ellison

The Norton pcAnywhere, Version 4.5, the first version of the popular remote-computing program to bear the name "Norton," is the first update of the product to come to market since Symantec acquired the program from Dynamic Microprocessor Associates (DMA) last August. This version joins the growing number of remote-computing products able to run Windows remotely in Real, Standard, and 386 Enhanced modes. It features a newer, faster file-transfer utility and offers unique management features that should appeal to large organizations that need account tracking and billing options.

The difficulty of running Windows (or any graphical software) remotely lies in the large amount of screen data that must be transmitted across a cable or phone line to the remote PC. Unlike screen information in text-based software, which is transmitted one character at a time, changes in a graphical environment redraw the full-screen bitmap presented on-screen. The data in that bitmap, which must be transmitted to the remote PC, can travel only as quickly as the modem or cable connection allows: 2,400, 9,600, or 19,200 bits per second over a modem or as high as 115,200 bps over a cable connection or over ISDN digital phone networks.

Like its competitors *Co/Session* and *Carbon Copy for Windows*, *pcAnywhere* tackles the task by replacing Windows' keyboard, mouse, and screen drivers with its own drivers in the Windows SYSTEM.INI file on the host PC (the PC that a remote user calls and accesses). It creates a backup of the original SYSTEM.INI file called SYSTEM .AW0. The *pcAnywhere* drivers intercept calls to the Windows drivers and communicate only screen changes, rather than the full-screen bitmap, to the waiting remote PC.

NO INORDINATE DELAYS

No remote-computing product has been able to refresh Windows on a remote screen at speeds comparable with those available to a local user, and *pcAnywhere* is no exception. But using two 386-based PCs connected via Hayes Ultra 96 modems, we were able to make simple document changes in *Microsoft Excel* and *Microsoft Word for Windows*, negotiate menus, size and drag windows, run DOS applications within Windows, and multitask among applications in 386 Enhanced mode without difficulty or inordinate delays. Windows operation is not recommended for users with modems slower than 9,600 bps.

pcAnywhere can be configured to run as a DOS application within a window on the remote PC, but for reliable performance, it should be run using the full screen. It cannot run within a window on the host, where it must be loaded and running ahead of Windows. The program can be loaded into high memory and consumes 62K to 100K RAM on the host, depending on how it is configured. For instance, *pcAnywhere* features an independent file-transfer utility, but the program can be configured to transfer files as a background operation from a hotkey menu on the host, an option that consumes 17K RAM.

Every *Norton pcAnywhere* remote caller can be assigned security specifications, including a password and the ability to perform only certain functions on the host.

IMPROVED FILE TRANSFER UTILITY

pcAnywhere's file-transfer utility, AWSEND, has been rewritten to achieve greater data compression and faster transfer times. We transferred a 102K .BMP file in 43 seconds, four text files totaling 106K in 50 seconds, and the 202K Windows SETUP.EXE file in 53 seconds. The resident pop-up transfer feature was much slower, just as Symantec's documentation warned it would be. It took more than 2 minutes to transfer the four text files even when the host was idle.

Version 4.5 adds Quick Connect, which lets users select a modem, dial a number, and immediately connect to a remote or host PC. It is good for what its name suggests—to make a quick connection to a waiting host. It is also especially useful for testing hardware configurations.

pcAnywhere's many security and management options give it its real value. Security options can be assigned individually according to user passwords, and passwords can be grouped under a "caller" location to allow systems managers to track remote activity by user, by account, or by location. A session log can be enabled on the host to track all incoming calls. An accounts billing feature on the host can track usage according to passwords, producing an accurate account of system usage by all users in one department or location. The activity log tracks usage by user name to create a history indicating exactly who dialed in when and how long they used the system. *pcAnywhere* can also be configured to record remote sessions in a series of screenshots, which can be replayed and reviewed later.

Passwords as long as 30 characters can be linked to DOS commands that are executed on log-in. This allows a manager or user using batch files to invoke a standard series of commands, such as those for printing a report, immediately upon logging into the machine. The program also includes a script language that lets you automate complex tasks.

Symantec released *The Norton pcAnywhere LAN*, Version 4.5, simultaneously with the serial version. The LAN version allows remote access to networks through a *pcAnywhere* gateway and provides the same features as the serial version in a network environment running NetBIOS or *NetWare*'s IPX. Both the serial version and the network version include ANSI, Data General, Digital Equipment Corp., and IBM terminal emulations, along with Kermit, Xmodem, and Ymodem transfer protocols. ■

FACT FILE

***The Norton pcAnywhere*, Version 4.5**
Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-253-9600.
List Price: $179; two-node license, LAN version, $495.
Requires: 512K RAM, DOS 2.0 or later.
In Short: The new version of *pcAnywhere* features faster file-transfer speeds and the ability to run Windows 3.0 applications and DOS applications within Windows in Real, Standard, or 386 Enhanced modes.
CIRCLE 421 ON READER SERVICE CARD

The Affordable Workgroup Hub That Expands Beyond The Department.

If your department has only a few people to connect together, you shouldn't be forced to buy a large or expensive hub system that you'll never completely use. But you shouldn't sell yourself short, either. You need the right equipment, right from the start.

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CIRCLE 146 ON READER SERVICE CARD

Small Footprint, Big Speed: Texas Instruments' PostScript Laser Prints 16 ppm

HANDS ON
by Alfred Poor

There's a new competitor in the shared PostScript printer market that proves good things can come in small packages. The TI microLaser XL Turbo from Texas Instruments lists for $3,649, and while the price is on a par with its competitors, this 16-page-per-minute printer, ideal for use on a LAN, comes with some clear advantages.

The printer is actually a relative of the TI microLaser XL that was reviewed in last year's printer issue (*PC Magazine*, November 26, 1991), with a special speed-enhancing Turbo option added. XL owners can upgrade their printers for $1,250, though the upgrade replaces a PostScript board if one is already installed.

The Turbo feature adds 2MB of memory plus a high-speed PostScript processor based on a Weitek 8220 RISC chip. Unlike most PostScript printers on the market, the TI microLaser XL Turbo is one of the new breed that offers Adobe PostScript Level 2 support. Most of Level 2's new features focus on color output, which is not relevant here, but this newer version is also designed to give better overall performance. The printer does come with special drivers for Windows 3.0.

FASTER THAN ITS PREDECESSOR

You'll find that the TI microLaser XL Turbo is fast. The text speeds are actually slightly slower than those reported for the XL in last fall's printer issue—14.2 ppm in PostScript and 13.7 ppm using LaserJet II emulation—but the PostScript graphics speeds are better. Here the XL Turbo is significantly faster than the XL: Using PostScript, it completed our graphics test page in 61.5 seconds; by contrast, the XL took 99 seconds.

In LaserJet II mode, the XL Turbo was about 3 seconds faster than the XL, with a time of 19.9 seconds for the graphics page. By comparison, the $5,495 HP LaserJet IIISi, which earned Editors' Choice honors last fall, is rated at 17 ppm and turned in the following results: 14.5 ppm for text and 45 seconds for graphics in PostScript, 14.6 ppm for text and 15 seconds for graphics in LaserJet mode.

SMALLER AND LIGHTER THAN THE HP

The TI microLaser XL Turbo is surprisingly small. Thanks to its Sharp print engine, it has one of the smallest footprints of any shared laser printer: 11 by 16.5 by 15.5 inches (HWD). At 45.1 pounds, it's also light for its class (the HP LaserJet IIISi weighs in at 106 pounds and measures 24 by 22 by 17 inches). The 250-sheet paper tray fits within the base of the printer so nothing sticks out of the rectangular shape to take up extra space.

Inside, the printer relies on separate toner, developer, and drum assemblies. When you set up the printer for the first time, you add toner and developer from a special dual-hopper container. This isn't foolproof, but it's relatively easy to add supplies without a spill. One definite plus is the fact that the photosensitive drum comes preinstalled, which eliminates the risk of scratching or otherwise damaging its delicate surface. Texas Instruments rates the life span of the toner cartridge at 6,000 pages, the developer cartridge at 30,000 pages, and the drum at 60,000 pages.

Print quality is very good, with smooth, solid coverage of black areas. The only flaw we noticed in the output is that the bottom edges of thick, black, horizontal lines sometimes show feathered edges.

The outside of the printer has a front panel that is fairly easy to use. A 16-character LCD window provides messages that allow you to configure the printer, including port settings, emulations, and fonts. You can also produce three different test reports as well as a three-page reference to the front-panel operation, just by pressing buttons on the panel.

The printer has three emulation modes: PostScript, LaserJet II, and a third named AES, which stands for Automatic Emulation Switching. This could be a convenient feature, especially in shared printer settings, but this implementation falls short of the mark. It watches for a specific character pair in the print stream (%!) to identify PostScript print jobs, and if it doesn't find them in the first 300 characters, it decides that the job must be in LaserJet mode and prints the document accordingly.

The problem is that not all PostScript header files contain this character pair (including the files used in the PC Magazine Labs printer benchmark tests), so the automatic switching does not work reliably. According to a Texas Instruments representative, the company is aware of the problem and is working to make the context switching more accurate.

One reason you might want to use the context-switching feature is that the printer supports concurrent users. It comes standard with parallel, serial, and AppleTalk ports. You can have two computers connected at one time: one to the parallel port and one to either the serial port or the AppleTalk port. Optional emulation choices include the Diablo 630 and IBM Proprinter.

SEVERAL PAPER-HANDLING OPTIONS

Paper handling is fairly good, with faceup and facedown outputs (faceup uses a foldout paper tray) and a manual feed slot that gives you a straight-through paper path when paired with faceup output. The 250-sheet paper tray is a bit small for shared use, but an optional bottom unit adds a 500-sheet tray so you can run longer without stopping to refill (list price $345). The output tray holds only 250 sheets, so you'll need to empty it just as often if you decide to get the 500-sheet paper tray.

Texas Instruments' microLaser line of printers has established a reputation as affordable PostScript printers with good performance. The XL Turbo continues to build on that reputation, offering excellent PostScript performance for a competitive price. ■

Texas Instruments' $3,649 TI microLaser XL Turbo is much smaller than its best-known competitor, the HP LaserJet IIISi.

PC MAGAZINE FACT FILE

TI microLaser XL Turbo
Texas Instruments Inc., P.O. Box 202230, Austin, TX 78714; 800-527-3500, 512-250-7407.
List Price: $3,649.
Dimensions: 11 by 16.5 by 15.5 inches (HWD); 45.1 pounds.
In Short: The microLaser XL Turbo offers PostScript Level 2 support with a fast Weitek RISC processor at a competitive price, making it an excellent choice as a shared PostScript printer.

CIRCLE 426 ON READER SERVICE CARD

ZEOS.

ZEOS is the best computer for your money, no matter how much you spend. Why?

Because ZEOS delivers to you high performance, fully compatible systems with more quality and features than anyone else. Not only that, but our after-the-sale support is second to none. And the prices? They're best described as incredible! It's no wonder *PC Magazine* has awarded ZEOS systems the coveted *Editors' Choice nine times.* Your new ZEOS Editors' Choice '486 is no exception.

After all, the ZEOS '486 upgradables are the hottest systems on the market today. *As PC Magazine says, "it's a lot of computer for a little cash."* And that's an understatement! No matter how much power you're looking for, ZEOS has it for you.

ZEOS COMPLETE SYSTEM PACKAGE #1

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486DX2-50	$1995
486DX-33	$1795
486SX-25	$1695
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We take Package #1 and upgrade your ZEOS Modular System to include:

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- ZEOS 14" High Res VGA Mono Monitor with Tilt & Swivel Base.
- Lotus 1-2-3 for Windows, *plus* Ami Pro 2.0 with Adobe Type Manager, *plus* Microsoft Windows and DOS 5.0, *plus* a genuine Microsoft mouse!

486DX-50	$2695
486DX2-50	$2495
486DX-33	$2295
486SX-25	$2195
486SX-20	$2095
PACKAGE #2	386-33 $1895

ANNOUNCING THREE HOT NEW PROCESSOR OPTIONS: '486SX-25, '486DX2-50 AND '486DX-50!

Go ahead and Pick your Power! ZEOS gives you all the options. You can start out by taking a look at the de facto desktop power standard, the 386DX-33. Our '386-33 workhorse is a great entry point for true desktop power computing. But if it's a '486 you're after, hang on to your hat!

Because you're off to a fast start with a 486SX-20 or our brand new 486SX-25. The 486SX is like a 486DX without the built-in math coprocessor. It's the easiest way to own the '486. And for full blown 486*DX* power, why not opt for your

PC Magazine calls it "the ultimate-power desktop PC." What will you call your new *ZEOS '486 Editors' Choice* system? Probably the hottest computer you've ever owned! And that's just for starters.

Because never before has so much value been available for so little money. We call it *ZEOS Value.* Starting with the incomparable ZEOS 386-33 right up thru our two new 486-50s. ZEOS gives you more for your money than anyone else.

ZEOS. Nine times Editors' Choice. Your Best Choice as Well!

First of all, our prices are great! You can get a ZEOS 386-33 upgradable for as little as $1,395. Or you can move right into a *complete 486DX2-50MHz for only $1,995.* Outrageous! And it's not just the price. It's all the extras we give you, too.

As an example, your new ZEOS Windows system comes complete with *Lotus 1-2-3 for Windows* and *Ami Pro 2.0 for Windows.* These are not trial copies or sample discs; they are full blown, fully documented production packages. And, with a suggested retail of over $1,000, even at "street prices" that's a *great* value. It's ZEOS value. After all, ZEOS sets the pace for innovation and value for you in the direct marketing channel. Here's another good example.

Upgradable.

GbsSlipBack-001B

Back

1. Follow instructions on the other side

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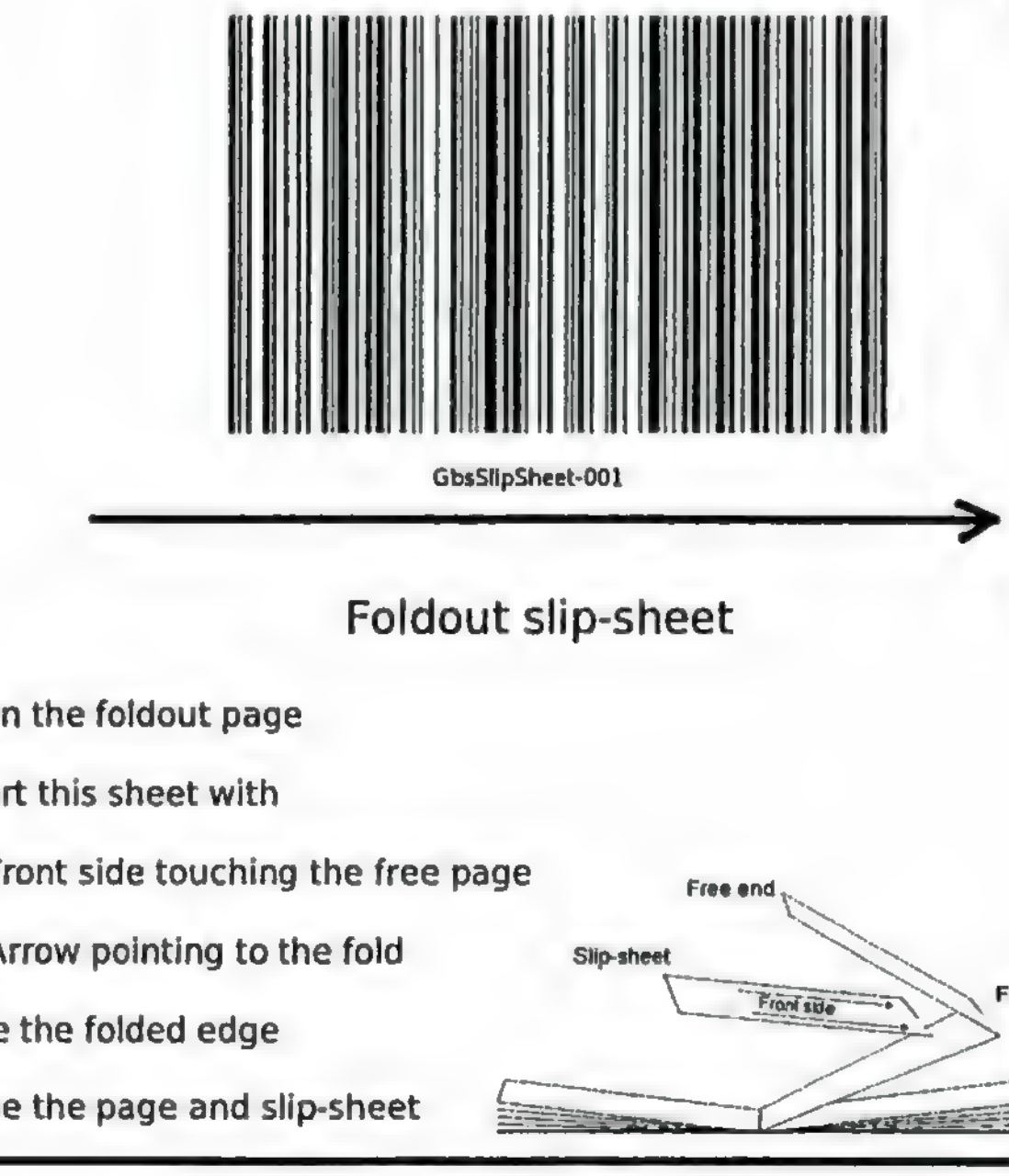
1. Follow instructions on the other side


Inverted Foldout slip-sheet
GbsSlipSheet-001
Foldout slip-sheet
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2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet
Free end
Slip-sheet
Front side

ZEOS.

ZEOS is the best computer for your money, no matter how much you spend. Why?

Because ZEOS delivers to you high performance, fully compatible systems with more quality and features than anyone else. Not only that, but our after-the-sale support is second to none. And the prices? They're best described as incredible! It's no wonder *PC Magazine* has awarded ZEOS systems the coveted *Editors' Choice nine times.* Your new ZEOS Editors' Choice '486 is no exception.

After all, the ZEOS '486 upgradables are the hottest systems on the market today. *As PC Magazine says, "it's a lot of computer for a little cash."* And that's an understatement! No matter how much power you're looking for, ZEOS has it for you.

ZEOS COMPLETE SYSTEM PACKAGE #1

- The Processor and Speed of your choice plus future upgradability!
- 1MB of High Speed RAM, expandable to a system total of 32MB right on the motherboard.
- 42MB High Speed IDE hard drive with its own cache.
- 1.2MB or 1.44MB Teac® floppy drive.
- ZEOS 14" flat screen Hi-Res amber monitor with Tilt/Swivel Base.
- Shadow RAM and EMS support for enhanced performance.
- ZEOS/RS 101 key SpaceSaver keyboard.
- Two Serial, one Parallel & one Game Port built right onto the motherboard.
- 7-16, 1-8 bit expansion slots. 80387 math co-processor support for '386 systems.
- Rugged ZEOS SpaceSaver case with twin cooling fans for added reliability and product life.
- Seven drive bays and our custom 300 watt power supply with built-in surge suppressor!
- Includes ZEOS 24-Hour-a-Day Toll-Free Technical Support and Customer Satisfaction package.

486DX-50	$2195
486DX2-50	$1995
486DX-33	$1795
486SX-25	$1695
486SX-20	$1595
PACKAGE #1	386-33 $1395

INCREDIBLE ZEOS PACKAGE #2

We take Package #1 and upgrade your ZEOS Modular System to include:

- 2 full Megabytes of Rip-roaring RAM.
- Our incredible 107MB IDE hard drive with its own built-in cache.
- Both the Teac® 1.2MB and 1.44MB floppy drives.
- Diamond SpeedStar Hi-Color VGA card/1MB RAM & Sierra DAC plus WinRIX drawing software!
- ZEOS 14" High Res VGA Mono Monitor with Tilt & Swivel Base.
- Lotus 1-2-3 for Windows, *plus* Ami Pro 2.0 with Adobe Type Manager, *plus* Microsoft Windows and DOS 5.0, *plus* a genuine Microsoft mouse!

486DX-50	$2695
486DX2-50	$2495
486DX-33	$2295
486SX-25	$2195
486SX-20	$2095
PACKAGE #2	386-33 $1895

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As an example, your new ZEOS Windows

This "Ultimate-Power Desktop PC" was chosen Editors' Choice.

Here's why.

More Power.

own *Editors' Choice* system!

It's the ZEOS Editors' Choice 486DX-33. Quite simply, there is nothing else like it. *PC Magazine* said, "the race toward 486 systems is faster than expected." One good reason for that is our *ZEOS Editors' Choice 486-33.* Go with the ZEOS '486 if you want the type of quality, performance and value that makes an *Editors' Choice* machine. And if it's *50MHz* you've been dreaming about, dream no more.

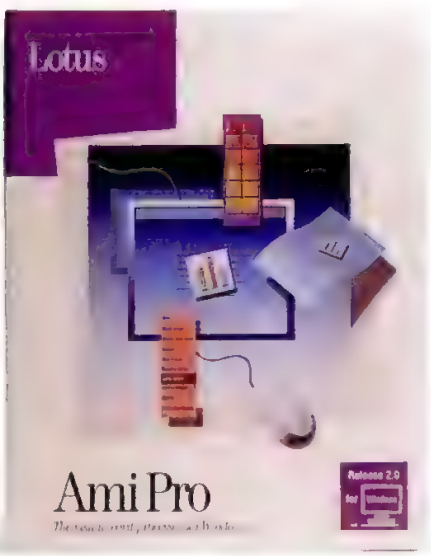
Because right here, right now, ZEOS gives you the option of '486 50MHz power! We're talking power unlike anything you've seen before. Take either the ZEOS 486DX2-50 or the 486DX-50. Absolutely unbelievable *performance!* And the price? That's what you really won't believe; only a couple hundred dollars more than the ZEOS 486-33. *Amazing.*

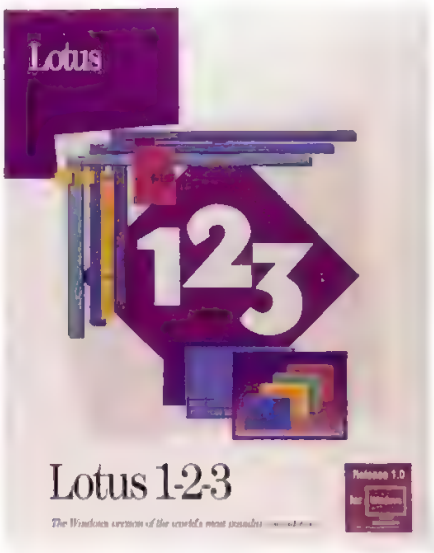
AND THAT'S JUST FOR STARTERS.

Because ZEOS combines the high speed upgradable processor of your choice with some of the fastest DRAM made. Both are mounted on your ZEOS system board, one of the most advanced in the industry. And that's where your new system really begins to shine.

Because to this we add an *incredibly fast* IDE hard drive and genuine Teac® floppy drives. We have located the ports for these drives right on the motherboard along with your serial, parallel and game ports. The result? Two slots are saved, giving your new ZEOS system a total of *eight.* All this while others are trying to get you to accept fewer slots. It's part of your ZEOS expansion advantage. The slots to expand, how about the room?

This is where ZEOS has performed something akin to magic. We call it our SpaceSaver case. Complete with *seven* drive bays (six with the DX-50), this incredible case is actually smaller than many cases offering only five drive bays. Plus, we've also added a *second whisper-quiet cooling fan.* Why? Because the cooler a system runs the longer it will last. Now





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Back

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1. Follow instructions on the other side

GbsSlipSheet-001

Foldout slip-sheet

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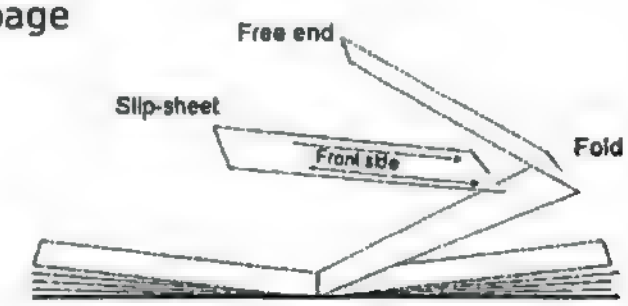
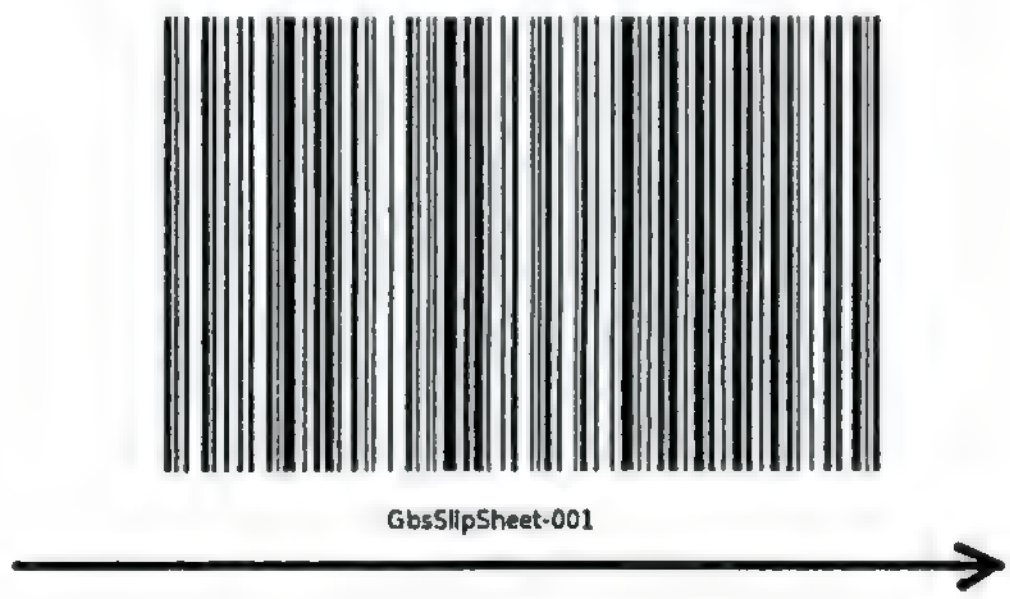
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Inverted Foldout slip-sheet

Open the foldout page
Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
Slice the folded edge
Close the page and slip-sheet

You have probably heard about the importance of protecting your new computer investment with a surge suppressor. Well, your new ZEOS upgradable desktop system already has one. *Built into the power supply!* That's innovation, built in from ZEOS.

Your new ZEOS system really is unlike anything else you can buy. It's better. Whether it's performance, quality, compatibility, upgradability, expandability, reliability, safety or support—whatever it is that you look for in a system, ZEOS has it. Here's another innovation we introduced to the hardware industry.

Zeos Windows systems include Lotus 1-2-3 for Windows plus Ami Pro 2.0 at no extra charge!

Low Cost.

Choose the Editors' Choice Upgradable. Now available as a 486-50!

24-Hour-a-Day Toll-Free Technical Support. While most of the others still only offer part-time technical support, as a ZEOS customer, you get around-the-clock 24-Hour-a-Day support, 365 days a year. Not that you'll need the help. But it's comforting to know if you do have a question, all you have to do is pick up the phone and give us a call, *any time* of the day or night!

And all of this is just for starters. Because when you turn the page we're going to talk about a lot of other very exciting and important reasons for you to buy from ZEOS. Like 486SX-25s, the new 486DX2-50, your ZEOS *Editors' Choice '486* and more. A whole lot more. *Come on in!*

confidence in support, in your system and in the company as well. You can buy with confidence too because ZEOS is a strong and rapidly growing public company (NASDAQ NMS Symbol: ZEOS). In fact, *Fortune* magazine rated ZEOS as *America's Fastest Growing Company.*

Price, Performance. Quality and Support. There are *many* reasons to buy your new ZEOS system. All of them backed by your ZEOS Customer Satisfaction Package which includes our 30-Day Money-Back Guarantee, One Full Year Limited Warranty and Express Parts Replacement Policy. How do you get one?

ORDERING IS EASY!

Ordering your new ZEOS system is indeed easy. Simply pick the

paded!

Power and Package you want or let us custom build your new system to your exact specifications! Whatever you decide, a friendly and knowledgeable ZEOS Systems Consultant is waiting to assist you. And whatever you select, one thing is for certain.

Buying your new ZEOS system is perhaps the best purchase decision you'll ever make. So why not give us a call right now. You're going to be very satisfied. We don't just say it. We guarantee it! *Call Now Toll Free, 800-423-5891.*

486DX-50 $3195
486DX2-50 $2995
486DX-33 $2795
486SX-25 $2695
486SX-20 $2595
386-33 $2395

INCREDIBLE ZEOS PACKAGE #3

Add even more memory, a larger drive. And more Savings! You now receive:

- 4 full Megabytes of Ultra High Speed RAM.
- Our fast 130MB IDE hard drive with built-in cache.
- Teac® 1.2 & 1.44MB FDD'S!
- Diamond SpeedStar Hi-Color VGA card/1MB RAM (32,000+ colors) plus WinRIX drawing software!
- ZEOS 14" 1024x768 Non-interlaced VGA Color Monitor w/Tilt & Swivel.
- Lotus 1-2-3 for Windows, Ami Pro 2.0 with Adobe Type Manager, Microsoft Windows, DOS 5.0 *plus* a Microsoft mouse!

PACKAGE #3

486DX-50 $3695
486DX2-50 $3495
486DX-33 $3295
486SX-25 $3195
486SX-20 $3095
386-33 $2895

THE ULTIMATE ZEOS PACKAGE #4

Now, Memory goes to 8MB and the drive to 210MB. PC Magazine *Editors' Choice* as a 486DX-33 Vertical!

- 8 full Megabytes of High Speed RAM.
- Your screaming 210MB IDE hard drive with its own built-in cache.
- Teac® 1.2 & 1.44MB FDD'S!
- Diamond SpeedStar Hi-Color VGA card/1MB RAM (32,000+ colors) plus WinRIX drawing software!
- ZEOS 14" 1024x768 Non-interlaced VGA Color Monitor w/Tilt & Swivel.
- Lotus 1-2-3 for Windows, Ami Pro 2.0 with Adobe Type Manager, Microsoft Windows, DOS 5.0 *plus* a Microsoft mouse!

PACKAGE #4

ORDER NOW TOLL FREE
800-423-5891

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Hearing Impaired (TDD): 800-228-5389
MasterCard, VISA, Discover, Am Exp, Z-CARD, COD and Leasing Programs.
GSA00K91AGS5176
Open 24 Hours a Day, 365 Days a Year!

that's ZEOS Value. Speaking of which, here's another industry first you will definitely benefit from.

ZEOS ANNOUNCES: BUILT-IN SURGE SUPPRESSION!

Right now, ZEOS is proud to announce that we've taken our top-of-the-line *300 watt* supply and added a *built-in surge suppressor.* Building the surge suppressor right into the power supply increases reliability and helps protect your investment. We wonder how long it will take for the rest of the industry to catch up. And while ZEOS is giving you critically important features like these, we add yet another.

UL Listing!* As *PC Magazine* said, UL Listing is "one of the few forms of peace of mind you can buy." Every ZEOS system is Underwriters Laboratories Listed. This means your entire system (not just the power supply) has met the stringent safety requirements of Underwriters Laboratories. Not only that, but your ZEOS UL listing says a lot about quality too. UL safety listings are something many of our competitors simply don't (or can't) provide you. At ZEOS quality and safety are important to us. *You are important to us!*

24-HOUR-A-DAY TOLL-FREE TECHNICAL SUPPORT.

The importance of having you as a customer shows in many other ways as well. For example, at ZEOS we believe supporting *you* should be more than a part-time proposition. As *PC Magazine* said, "Insist on a good service and support package. Expect...24-hour seven-day-a-week support." We've been saying that for years. In fact, it was ZEOS that invented *24-Hour-a-Day Toll-Free Sales and Technical Support.* Our customers tell us they love it. And you will too. Any time you need assistance, a ZEOS technician is only a phone call away.

With ZEOS you can have complete

Great Prices. L

For a limited time only, in addition to Microsoft DOS 5.0, Windows and a MS mouse, every ZEOS Windows System also includes Lotus 1-2-3 for Windows plus Ami Pro 2.0 plus Adobe Type Manager. No additional charge! You're going to love it!*

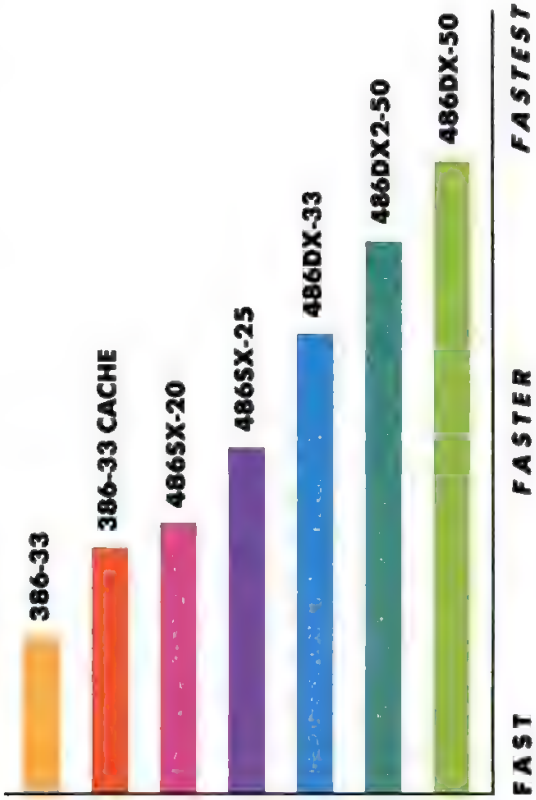
Or
Customize, Customize, Customize!
Just Tell Us and We'll Do It.

Pick Your Power!

Now, ZEOS lets you pick exactly the power you want for the price you want to pay. Simply match the processor with the package configuration and you have your price. Or if you wish, we will custom build any system to your exact specifications.

And don't forget, with every ZEOS Windows System (packages 2, 3 and 4) you'll also receive Lotus *1-2-3 for Windows* plus Lotus's new word processor for Windows, *Ami Pro 2.0.* The Lotus software alone carries a suggested retail of over $1,000 and even street prices are over $700. Yet we're giving it to you at *no additional charge!* That's ZEOS value.

No doubt about it. ZEOS has broken the price/performance barrier with these great new upgradables,



Z•SPEED GRAPHOMETER

Let the "Z-Graphometer" help you pick the processing power that's right for you. The comparisons are easy to make. Fast, Faster or Fastest!

ZEOS COMPLETE SYSTEM PACKAGE #1

- The Processor and Speed of your choice plus future upgradability!
- 1MB of High Speed RAM, expandable to a system total of 32MB right on the motherboard.
- 42MB High Speed IDE hard drive with its own cache.
- 1.2MB or 1.44MB Teac® floppy drive.
- ZEOS 14" flat screen Hi-Res amber monitor with Tilt/Swivel Base.
- Shadow RAM and EMS support for enhanced performance.
- ZEOS/RS 101 key SpaceSaver keyboard.
- Two Serial, one Parallel & one Game Port built right onto the motherboard.
- 7-16, 1-8 bit expansion slots. 80387 math co-processor support for '386 systems.
- Rugged ZEOS SpaceSaver case with twin cooling fans for added reliability and product life.
- Seven drive bays and our custom 300 watt power supply with built-in surge suppressor!
- Includes ZEOS 24-Hour-a-Day Toll-Free Technical Support and Customer Satisfaction package.

INCREDIBLE ZEOS PACKAGE #2

We take Package #1 and upgrade your ZEOS Modular System to include:

- 2 full Megabytes of Rip-roaring RAM.
- Our incredible 107MB IDE hard drive with its own built-in cache.
- Both the Teac® 1.2MB *and* 1.44MB floppy drives.
- Diamond SpeedStar Hi-Color VGA card/1MB RAM & Sierra DAC plus WinRIX drawing software!
- ZEOS 14" High Res VGA Mono Monitor with Tilt & Swivel Base.
- Lotus 1-2-3 for Windows, *plus* Ami Pro 2.0 with Adobe Type Manager, *plus* Microsoft Windows and DOS 5.0, *plus* a genuine Microsoft mouse!

and you're the beneficiary. Incredible power, upgradability, and free software. What more could there be? From ZEOS, lots more.

Because your new ZEOS system is not only fast, it's absolutely loaded with features. Like our 300 watt power supply with *built-in surge suppression,* eight expansion slots, twin cooling fans for even more reliability, plus our unique seven bay SpaceSaver case. And, every ZEOS system is UL® listed.

And don't forget you're also receiving 24-Hour-a-Day Toll-Free Technical Support, our 30 day Absolute Satisfaction Money-Back Guarantee, Express Parts Replacement and more. So go ahead.

Pick your Power, your Package, and your Price and give us a call. Your friendly, expert ZEOS Systems Consultant is ready to answer any questions you may have. *Call Now Toll Free 800-423-5891.*

PACKAGES 2, 3 AND 4 INCLUDE LOTUS BUNDLE!

	Pkg. #1	Pkg. #2	Pkg. #3	Pkg. #4
386-33	$1395	$1895	$2395	$2895
486SX-20	$1595	$2095	$2595	$3095
486SX-25	$1695	$2195	$2695	$3195
486DX-33	$1795	$2295	$2795	$3295
486DX2-50	$1995	$2495	$2995	$3495
486DX-50	$2195	$2695	$3195	$3695

Add $200 to any price for a 128K cache. 486DX-50 SpaceSaver case has 6 bays.

PICK YOUR PAYMENT OPTION TOO:

When you buy from ZEOS you have a wide variety of payment options. We accept MasterCard, VISA, American Express and Discover cards, or if you wish we can ship COD.

We also have our own ZEOS credit card, the "Z-Card.™" The Z-Card allows you to charge your ZEOS purchases just like a MasterCard or VISA. There is a low consumer rate and there is no annual fee. We can send you an application or you can apply right over the phone. Our special toll-free application number is 800-421-8942.

ZEOS also offers a terrific leasing program for businesses. The rates are lower than those charged by most of the others in our industry. We will promptly mail or fax you an application on request. Just give us a call at 800-423-5891.

Purchase orders from Fortune 1000 companies, governments and institutions are subject to credit approval. Wire transfer is also available. Please call 800-423-5891 for details.

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Add even more memory, a larger drive. And more Savings! You now receive:

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- **Diamond SpeedStar Hi-Color VGA card/1MB RAM (32,000+ colors) plus WinRIX drawing software!**
- **ZEOS 14" 1024x768 Non-interlaced VGA Color Monitor w/Tilt & Swivel.**
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- **Lotus 1-2-3 for Windows, Ami Pro 2.0 with Adobe Type Manager, Microsoft Windows, DOS 5.0 *plus* a Microsoft mouse!**

ORDER NOW TOLL FREE

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Outside U.S. and Canada Call: 612-633-6131
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MasterCard, VISA, Discover, Am Exp, Z-CARD, COD and Leasing Programs.
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Open 24 Hours a Day, 365 Days a Year!

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If you thought power like this was out of your budget, take another look. While many of the others don't even offer 50MHz power, you can own the new ZEOS 486DX2-50 starting *complete for as low as $1995!*

Starting at $1995, you can select from any of four money-saving ZEOS System Packages. Or, if you wish, let us custom-build your hot new 486-50 to your exact specifications.

ZEOS POWER GRID FOR THE 486DX2-50

Apply The "Zeos Power Grid" To Match Your 50MHz Needs: Add $200 for 128K cache. Prices shown are for Intel 486DX2-50 CPU; for 486DX-50 add $200.

	Intel 80486DX2-50MHz	Upgradable CPU	1MB High Speed RAM	2MB High Speed RAM	4MB High Speed RAM	8MB High Speed RAM	42MB HDD, Fast IDE	107MB HDD, Fast IDE	130MB HDD, Fast IDE	210MB HDD, Fast IDE	Teac 1.2 Floppy Drive	Teac 1.44 Floppy Drive	14" Hi Res TTL Monitor	14" VGA Mono Monitor	14" VGA Color 1024 x 768 NI	Monitor Tilt & Swivel	Hercules® Graphics Card	Hi-Color VGA Card, 1MB	Sierra DAC	Shadow RAM/EMS Support	ZEOS/RS 101 keyboard	2 serial, 1 parallel, 1 game port
Pkg. #1 Only $1995	■	■	■				■				■		■		■	■				■	■	■
Pkg. #2 Only $2495	■	■		■				■			■	■		■	■			■	■	■	■	■
Pkg. #3 Only $2995	■	■			■				■		■	■			■	■		■	■	■	■	■
Pkg. #4 Only $3495	■	■				■				■	■	■			■	■		■	■	■	■	■

WHAT SHOULD I GET?

How should you configure your new ZEOS 486-50? Of course the best answer depends on your needs and what you plan to use your new system for. But never before has so much power been available to everyone at such a low price. Our suggestion would be to consider investing in two areas when you buy your new 50MHz system. The memory and drives. Particularly the memory.

From what we're hearing, memory will be important with the new operating systems debuting later this year. We would strongly recommend at least 4 megabytes, eight if it's in the budget. As for drives, think in terms of 100+ megabytes; applications just don't seem to be shrinking (however, before you go too wild, remember you can always add more drives). Both of our Packages #3 and #4 incorporate these suggestions.

Certainly another option you may want to consider is our Vertical case. This heavy-

Your 486

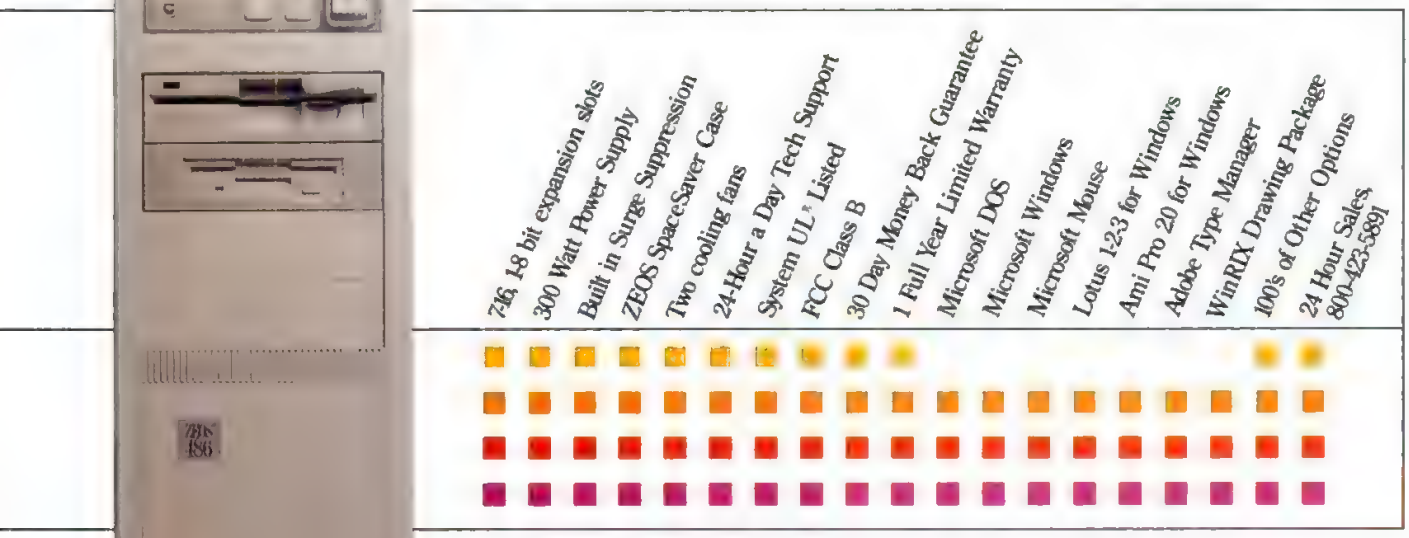
ZEOS Breaks the '486-

duty case holds more drives than most others and has a top-notch power supply and plenty of cooling.

It really is quite a buy. The power supply is the *TurboCool 300 watt* unit (check the retail price of the power supply alone if you really want to see what a good deal you're getting). It's well worth considering.

YOUR ZEOS EXTRAS. NO EXTRA CHARGE.

And don't forget, if you purchase a ZEOS Windows system we'll also include



Consider the Vertical Option. We can build your new upgradable system in our eight bay vertical case. It comes complete with the 300 watt TurboCool power supply and two cooling fans. Add only $150.

Lotus *1-2-3 for Windows* plus *Ami Pro 2.0* with *Adobe Type Manager.* You'll be getting all the other ZEOS extras too.

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Fast New Cartridge From HP Brings Level 2 PostScript to LaserJet III

HANDS ON
by Edward Mendelson

Hewlett-Packard's $695 HP PostScript Cartridge Plus is the first LaserJet cartridge that incorporates PostScript Level 2, Adobe's faster and more flexible version of its page description language. The cartridge comes with software that lets you switch your printer between PostScript and LaserJet modes automatically without turning it off. (This feature appeared in all other PostScript cartridges except the original HP PostScript Cartridge.)

The new cartridge works only with the HP LaserJet III, IIID, and IIIP. As with other PostScript cartridges, the printer defaults to PostScript mode when you switch it on—but unlike all other PostScript cartridges, the new HP model lets you change the default so that the printer will act as a LaserJet when first turned on. That's a major convenience if you primarily use the LaserJet's native language, PCL. Whichever mode the printer starts up in, the supplied software detects whether you're printing in PostScript or LaserJet format and makes the printer switch modes automatically.

PostScript Level 2 produces dramatic speed improvements over earlier versions. A one-page *Word for Windows* file with two soft fonts took 90 seconds to print with the original HP PostScript cartridge and only 70 seconds with the new model. A graphic that took the earlier model 2 minutes 35 seconds now needs only 1 minute 15 seconds.

With Pacific Data Products' Pacific Page XL cartridge, which comes with a coprocessor mounted on a RAM board that you plug into the printer, the graphic took only 55 seconds. However, the text file took 10 seconds longer than with the new HP cartridge because the PDP coprocessor affects only graphics printing. Compared with the third-party PostScript interpreter in the PDP cartridge, the true Adobe code in the HP model produces superior font quality. As with other PostScript cartridges, you'll need at least 1MB of extra RAM in your printer.

The cartridge comes with a copy of *Adobe Type Manager for Windows*, complete with WYSIWYG screen fonts for all 35 fonts built into the cartridge. (When you buy *ATM* alone, it includes only 13 fonts.) You also get Adobe's new Windows PostScript driver, which supports Level 2 features, and the device driver that automatically switches the printer between LaserJet and PostScript modes.

The device driver doesn't work if you use LaserTools Corp.'s *PrintCache* software, but we discovered that you can effectively solve that problem by loading the TSR version of the software after you load *PrintCache*.

You can upgrade from the original HP cartridge for $195, and HP continues to sell the original for $495. The new model is the finest PostScript cartridge on the market, and—for text printing—the fastest. ■

List Price: HP PostScript Cartridge Plus, $695. Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900. **Requires:** HP LaserJet III, IIID, or IIIP, with 1MB additional RAM.

CIRCLE 427 ON READER SERVICE CARD

Statgraphics Plus: A Quick Route to Heavy-Duty Data Analysis

HANDS ON
by Wendy Dugas Pérez

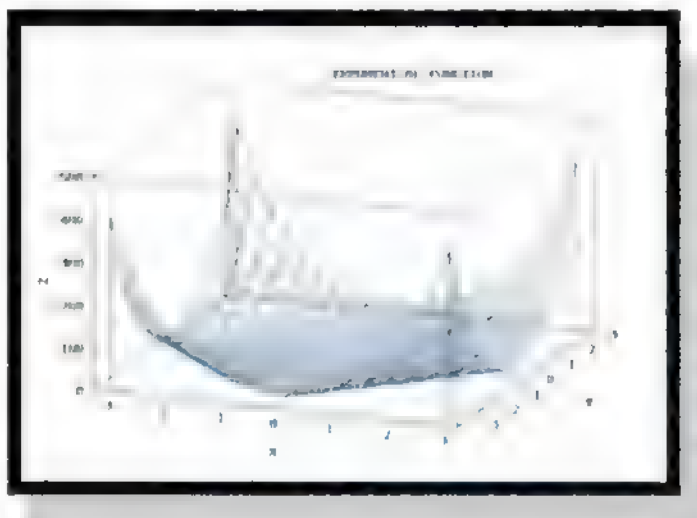
One of the challenges of statistics is to transform raw data into a form from which you can draw conclusions. *Statgraphics Plus*, Version 5.0, is statistical visualization software from STSC that provide you with the tools to do just that. Priced at $1,595, it's one of the few software packages that successfully combine complex functionality with relatively easy operation.

While *Statgraphics* has always fared well in competition with other statistical packages, it has often been criticized for its lackluster speed and limited capacity. In addition to offering *Statgraphics*, Version 5.0 (which can run on any PC), STSC has designed *Statgraphics Plus* specifically for the 386/486, enabling it to take advantage of fast 32-bit operations. In *Statgraphics Plus*, the size of data sets is dependent only on RAM, with no limits set from within the package; the more RAM you have, the larger your data sets can be.

Statgraphics has over 250 statistical, mathematical, quality and process control, optimization, and experimental design procedures. New graphics included in both *Statgraphics* 5.0 and *Statgraphics Plus* are Pareto charts for effects, square and cube plots, interaction and main-effect plots, normal and half-normal plots, and diagnostic residual plots. You'll also find enhancements made to its multifactor and one-way ANOVA procedures. You can now selectively add or delete interaction terms as well as choose the error term to use for significance tests.

One of the most useful features of *Statgraphics Plus* is its interactive graphics ability, which allows you to manipulate and edit the data underlying graphs and to create instant what-if scenarios. Graphics can also be exported as metafiles for use in other applications.

STSC has completely rewritten the documentation for *Statgraphics Plus*. The three-volume set includes a Quickstart guide, a user manual, and a large reference manual that provides information on each statistical procedure. It's designed to get you up and running quickly, and it does just that.



One of *Statgraphics Plus*'s many graphing options is this Response Surface Plot of an exponential function.

Upgrading to *Statgraphics Plus* is a painless process if you're already using *Statgraphics*, since both programs function in the same way. You can convert data, graphics, and experimental design files between the two programs either during installation or by using a utility routine. If you are currently running *Statgraphics* 5.0 you will have to pay $595 to move up to the *Plus* version. It costs $895 to upgrade from versions prior to 5.0.

With good documentation and an easy-to-use menu-driven interface, *Statgraphics* is great for the novice user who needs to analyze data. And now with *Statgraphics Plus*'s 32-bit operations and virtually unlimited data-set size, as well as its wealth of mathematical and statistical functions, more advanced statisticians will find that it satisfies their needs as well. ■

List Price: *Statgraphics Plus*, Version 5.0, $1,595. STSC Inc., 2115 E. Jefferson St., Rockville, MD 20852; 800-592-0050, 301-984-5123.

Requires: 386SX-based PC or better, 4MB RAM, DOS 3.3 or later. Math coprocessor recommended.

CIRCLE 428 ON READER SERVICE CARD

Bravado Brings Full-Motion Video to Your Screen

HANDS ON
by John R. Quain

Why wait? While industry analysts ponder the potential of full-motion video, Truevision, which set a de facto graphics standard with its Targa boards back in 1985, is trying to follow that success in the full-motion video arena with the $1,295 Truevision Bravado multimedia engine.

The Bravado is a VGA full-motion composite video decoder and pass-through audio subsystem on a single full-length 16-bit ISA board. It allows users to display a full-motion, 30 frame-per-second video window under Windows on a standard VGA monitor. By connecting the Bravado to a composite video source such as a VCR, a laser disk player, or a camcorder, you can use it for video conferencing, multimedia presentations, or to capture live video frames.

Connections for the Bravado include a regular 15-pin VGA monitor hookup and a 25-pin connector. The latter can accommodate two audio inputs and up to three NTSC (National Television Standards Committee) or PAL (Phase Alternative Line) video sources. Though it will only display one video source at a time, the Bravado includes an internal video bus connector that can be used to cascade or daisy-chain other Bravado boards together. In this manner, up to five full-motion video windows can be displayed simultaneously.

Independent on-board VGA control is provided by a Tseng Labs ET4000 controller with 512K of DRAM. The VGA section delivers 8-bit-per-pixel color (256 colors) and a maximum noninterlaced resolution of 800 by 600 pixels (SVGA) at a 60-Hz vertical refresh rate. Having VGA control on the full-motion video board means you don't have to use another expansion slot for a separate VGA card.

FULL-MOTION FEATURES

The full-motion video section of the Bravado is controlled by Chips & Technologies' PC video controller with a 786K VRAM video frame buffer. Composite video fed into the board is decoded into digital information and then manipulated by the C&T controller for display in a video window. The video window displays the equivalent of 21-bit-per-pixel color at a maximum resolution of 800 by 600 pixels. The video window is completely scalable, with a maximum full-screen size of 704 by 490 pixels.

In our testing, the Bravado did not suffer from the image lag or picture snow that can plague poorly decoded composite video images. The Bravado delivered image quality comparable to the image quality of a conventional television. However, the shortcomings of the original video source tend to be magnified.

The Bravado's audio section delivers an amplified 2-watt, 8-ohm output for standard speakers or an unamplified line-level output for self-powered speakers or an external amplifier. The two outputs provide the best of both worlds: Multimedia presentations for large audiences can use the line-level output for external amplification while single-user configurations can use small unamplified speakers or headphones.

SIMPLE WINDOWS CONTROLS

All controls are accessed easily via Windows pull-down menus and dialog boxes. A still image, for example, can be grabbed from the full-motion video window simply by selecting a dialog box, creating a filename, and then waiting until the right moment arrives and clicking on the mouse. Images can be stored in Truevision's .TGA (24- or 16-bit) file format or in IBM's MMotion (12-bit .YUV) format.

Additional controls include digital slider bars to adjust the brightness, color saturation, and contrast of the full-motion or captured image inside the window. Finer control is provided by red, green, and blue color signal adjustments.

One special video effect the Bravado offers is a masking option that blocks out portions of the incoming live video. Using the mask control panel, portions of the luminance (brightness) or chrominance (color) video signal can be blocked out, creating a ghostly MTV-style effect.

More practical controls include the ability to make the video window fully scalable and the ability to maintain the image's aspect ratio as you resize the window or crop the image. A zoom option is provided that can display an image at one, two, four, or eight times its original size.

The standard supplied 25-pin connecting cable splits into four jacks: two RCA inputs for stereo audio, one RCA input for composite (NTSC) video, and one minijack for stereo output. Some external video players can be directly controlled by the Bravado software. By selecting the appropriate driver and connecting the player to a serial port, users can gain on-screen control over such devices as the NEC PC-VCR, Sony LDP, and TEAC laser disk players.

Truevision plans to ship a 16-bit-per-pixel version of the Bravado later this year. It will offer three additional internal connectors: an audio interface for dedicated audio boards, an encoder bus for daughterboards capable of outputting recordable composite video, and an AT-bus hookup for add-on modules. The Bravado 16 will also support S-video and 32,768 colors in SVGA.

The 8-bit Bravado isn't quite the soup-to-nuts, all-in-one multimedia Holy Grail—you can't directly connect a CD-ROM drive or output recordable NTSC video—but it has potential. A few hardware and software companies, including MPEG and JPEG video compression board makers, have already announced plans to support the Bravado. Its success will depend largely on how extensive third-party adapter support becomes. For now, it offers a fine full-motion video/VGA solution. ■

The Bravado board offers full-motion video in a resizable window, ideal for multimedia apps.

FACT FILE

Truevision Bravado
Truevision Inc 7340 Shadeland Station, Indianapolis, IN 46256, 800-344-8783; 317-841-0332.
List Price: $1,295.
Requires: VGA monitor, 16-bit expansion slot, Microsoft Windows 3.0 or later, speakers or headphones.
In Short: A single-slot full-motion video adapter with independent VGA control, the Bravado delivers real-time, 30-frame-per-second video in a window. The adapter is flexible, easy to control under Windows 3.0, and offers excellent image quality.

CIRCLE 433 ON READER SERVICE CARD

An open letter to dBASE users

From Philippe Kahn, Chairman of Borland

I am proud to announce dBASE IV® version 1.5, the first version of dBASE® since we acquired Ashton-Tate four months ago, is now available.

Version 1.5 is a faster, easier-to-use and more powerful version of dBASE. New features include mouse support, faster Query By Example data retrieval, 40 work areas, new BLANK support that lets you detect when fields are empty, open architecture Control Center, editable multi-file views, C language–like file I/O so dBASE programs can read and write files of any type, as well as other enhancements.

Borland has tested dBASE IV thoroughly. We stand behind it. In fact, to ensure your satisfaction, we'll guarantee you a complete, no-questions-asked refund, within 60 days of purchase if you are not totally satisfied.

What's next? We have several development teams working right now to build the latest technology into dBASE. For example, we will bring a dBASE compiler for Windows to market, which owners of the Developer's Edition will receive *free!* And we're putting this same technology into a DOS dBASE compiler. Of course, we will continue to enhance dBASE across platforms, including UNIX and VAX VMS.

I want to make sure that I get your feedback about our dBASE products. Call my Voicemail directly at 1-800-851-2122 with your critiques and suggestions. I'll personally make sure that your thoughts are taken into full account by our development team.

At Borland, we are committed to building the products you need. dBASE IV version 1.5 is an important, first step in the right direction.

Thank You,

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CIRCLE 295 ON READER SERVICE CARD

Texim: High-End Project Management with Mainstream Look and Feel

by Henry Fersko-Weiss

Traditionally, high-end project management packages let you handle projects of any size, but you have to be an expert to do it. *Texim Project* breaks new ground by combining very sophisticated modeling capabilities for projects of any size with the easy-to-use *GEM* interface. And at a cost of $1,295, its price is hundreds to thousands of dollars below high-end products like *ViewPoint* and *Primavera Project Planner*.

Running in the *GEM* environment, *Texim Project* offers rich graphics with multiple font selections, different line and fill patterns, and color options for charts and text. The interface uses scrollbars, dialog boxes, multiple windows (up to four), icons, and rubberband marking of multiple objects.

DRAG-AND-DROP PROJECT SETUP

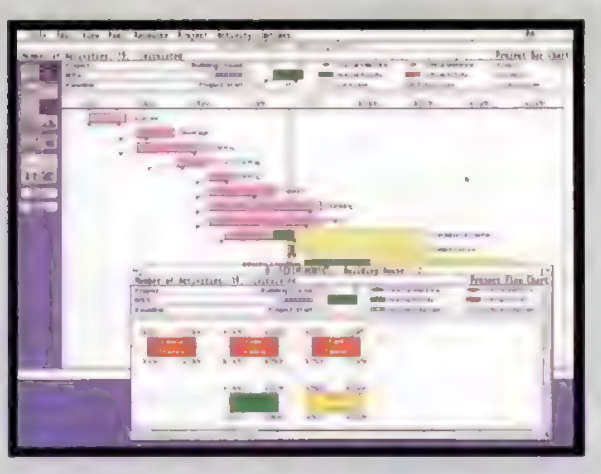
The graphics make it quite easy to set up a project. Double-clicking anywhere on a blank chart positions a task bar or box on the chart and automatically opens the appropriate data entry dialog box. Tasks can be entered through the bar chart (Gantt), linked bar chart, flowchart (network diagram), and work breakdown structure (WBS) chart. Or you can enter tasks through several table views.

In the Activities Data box, you set a WBS code, task type, and status. You also indicate the activity's priority, overhead cost, and whether the job is time- or resource-driven. After you've placed a number of bars or boxes on your chart, you can easily drag them around and zoom in or out on details. You can't manipulate bars directly to increase task duration or to change the start date.

An icon panel on the left side of the screen can be used to change and fine-tune your project views. For example, you could use an icon to bring up the flowchart view and then click on the Subscreens icon to choose line connections between the task boxes or arrows.

Although *Texim Project* doesn't offer outlining, it uses a multilevel approach to project structure that is based on the WBS codes. You can view this structure most clearly in the WBS chart. Each time you double-click on a WBS box, you drop down a level until you reach the flowchart for individual project segments or subprojects. You can then easily jump back up a level by clicking on the Backup box at the left end of the title bar.

Texim Project allows you to have up to 200 activities per level, and each activity can be a placeholder for the next level down; therefore, a project can have as many tasks as you want, limited only by your hard disk space. Going to disk all the time slows the program down, so the manual recommends building a RAM disk to hold a project in memory. Even then, the program calculates and refreshes the screen a bit slowly.



This bar chart in *Texim Project* shows progress and float over a baseline measure. The bottom windows display a flowchart of the same project.

The real sophistication comes when you start to enter task durations. You can enter one duration for calculating the critical path or use true PERT analysis to enter optimistic, most likely, and pessimistic durations. Using PERT analysis lets you apply a mean duration to tasks and a standard deviation. An Analysis Methods dialog box lets you choose one of four statistical calculations and one of four distribution curves. To add to the complexity of the modeling scheme, you can pick scheduling methods based on time analysis, resource smoothing within float, or resource leveling.

SMART RESOURCE MANAGEMENT

Resources are the other major focus of *Texim Project*. You work with resources by creating an OBS (organizational breakdown structure) for your project. Like the WBS structure, it is hierarchical, but now the levels represent resource pools. For example, you might have a top-level pool for labor, a level under that with engineers, and finally a level with individual engineers by name. Individual resources have availability and efficiency factors as well as cost and billing factors. Each resource can have its own calendar, as can resource pools. The program also offers a project calendar and individual activity calendars.

The one weakness in resource modeling is that it doesn't allow you to split assignments during a task. You can assign a resource part-time to a task and override the effort factor for a task, but you can't indicate that an engineer works for two days at the beginning of a task and then two days at the end.

WHAT-IF TOOL RETHINKS TIME AND COST

Texim Project has a useful What-If tool that lets you increase or decrease task durations and costs for groups of tasks or resources by using WBS or OBS codes (or both). Then, by resetting the factoring number to 1.00, you can return a schedule to the original specifications.

While the scheduling and modeling functions in the program offer great sophistication, the reporting features don't measure up as well. They let you print out any of the project views, but you can't create cross-tabulated reports or build new tabular views. One welcome reporting feature is the ability to group a number of reports into a compound report and save it in a library.

Texim Project gives you an easy-to-use graphical interface and sophisticated project planning functions. It also lets you schedule unlimited tasks. In these ways, it acts like a high-end product—with a midrange price. If you spend most of your time modeling projects, *Texim Project* has a lot to offer. ■

FACT FILE

***Texim Project*, Version 1.1**
Texim Inc., 833 Portland Ave., St. Paul, MN 55104; 612-290-9627.
List Price: $1,295; LAN version, $2,495.
Requires: 640K RAM, 3MB hard disk space, DOS 2.1 or later
In Short: *Texim Project* lets you plan projects using sophisticated modeling techniques. The program allows you to have projects of unlimited size the same way high-end products do, but you don't pay a price in usability; the *GEM*-based graphics in *Texim Project* make it very easy to use.

CIRCLE 430 ON READER SERVICE CARD

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? Yes, but almost no room remains for data
*Yes, but requires attaching an add-in

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[1]1991 J.D. Power and Associates® Computer End User Satisfaction Study: Phases I and III: Small to Medium-sized Businesses (responses from 1,784 business sites with 1 to 499 employees) and Large Businesses (responses from 1,094 business sites with 500 or more employees). Copyright © 1992 Borland International, Inc. All rights reserved. Pricing is in U.S. dollars. Offer good in U.S. and Canada only. Dealer prices may vary. BI 1471

CIRCLE 287 ON READER SERVICE CARD

Qmodem Goes Retail, Adds Off-Line Reader

HANDS ON
by Joe Salem

Version 5.01 of the greatly popular communications software *Qmodem* ($99) introduces two big changes: It's no longer a shareware package, and it includes an off-line message reader for BBS users. Mustang Software, the makers of the BBS software *WildCat!*, has purchased *Qmodem* from the Forbin Project and *Qmodem* 5.0 is the first commercial release under its name. *Qmodem* 4.5 is being rereleased by Mustang as a test-drive version of 5.0 that will be available for download from a number of on-line services.

The other big news is the addition of OLX (Off-Line Xpress), an off-line reader for BBSs that support the .QWK mail-packet format. The *QMail* (or *QwikMail*) software, which runs on many BBS systems, scans the BBS for all new messages in the conferences selected by the user. Then it packs them up for downloading using one of the common file archive utilities such as *ARC Plus* or *PKZIP*. Once the mail is downloaded, the user can read and reply to the messages off-line and upload a response packet to the BBS on the next call.

Using an off-line reader benefits both BBS users and BBS sysops (system operators). Users can save time and money by being able to read new messages at their leisure without the clock ticking away on phone charges. Sysops can make their BBSs available to more users, since those with off-line readers won't be tying up the phone lines.

OLX is an enhanced version of a former shareware program called *SLMR* (*Silly Little Mail Reader*), put out by Technique Computer Systems (which has also become a part of Mustang Software). It includes a simple text editor called OLXED for writing responses, but users can replace it with any text editor that creates standard ASCII files. The off-line reader can be run either standalone or from within *Qmodem* through the Alt-M key combination.

The new version of *Qmodem* also has some minor enhancements and bug fixes. The internal ZModem file-transfer protocol has been enhanced, using techniques Mustang developed for the ZModem in their *WildCat!* software. Three new terminal emulations (IBM 3101, VT52, and HEATH) have been added as well. The dialing directory, already above average, has also been enhanced.

One file-transfer protocol is noticeably lacking in this version: Compuserve's CIS-B. Mustang has stated that it will be included in Version 6.0, a major rewrite of the program due sometime in the third quarter of 1992.

The Off-Line Xpress message reader included with *Qmodem* 5.01 gives BBS users the ability to read and reply to a large number of messages at their convenience.

The impact of Mustang's communications experience on *Qmodem*, as well as its availability through normal software outlets, may be enough to restore it to its former position as one of the top comm programs available. As more and more PC users discover BBSs and BBS networks, the availability of off-line readers will be an important factor in making those communications more efficient. Including OLX with *Qmodem* is a smart move on Mustang's part. ■

List Price: *Qmodem*, Version 5.01, $99; upgrade, $35. Mustang Software Inc., P.O. Box 2264, Bakersfield, CA 93303; 805-395-0223; BBS: 805-395-0650. **Requires:** 384K RAM, DOS 2.0 or later.

CIRCLE 401 ON READER SERVICE CARD

System Sleuth Tests and Reports on Hardware and Software

HANDS ON
by Edward Mendelson

As computers grow more complex and difficult to configure, the tools that analyze them get more ingenious and intelligent. Version 4.0 of Dariana's $169 *System Sleuth Professional* tells you facts about the insides of your computer that few other system-analyzing programs can tell you. Like all such tools, however, it can't tell you everything you need to know when installing new hardware in an already packed machine.

System Sleuth consists of two separate programs: one for analyzing the configuration of your computer and the other for testing your hardware. The system analyzer looks like a character-based version of Windows, and it lets you keep multiple windows open on-screen with reports on different aspects of your system.

You run the program with all your normal TSRs and device drivers loaded, and get reports on programs loaded in memory, interrupts and IRQs, EMS and XMS memory, I/O ports, and upper memory. Some data is presented in a laconic style that will be useful only to highly technical users, as it lacks the clarity of Quarterdeck's *Manifest*, a popular system-analyzing program. But *System Sleuth* conveniently lets you view the contents of memory and files, which only a few comparable packages (notably Merrill & Bryan's *InfoSpotter*) allow you to do.

Another uncommon and especially valuable feature—shared only by *System Sleuth*'s cousin, Dariana's *WinSleuth Professional* (evaluated in First Looks, February 25, 1992)—is an Installation Assistant that identifies available I/O addresses for add-in boards. Often, the only way to learn the addresses used by your add-in boards is to find the manual and check the switch settings. *System Sleuth* lets you enter the address that your new board wants to use and tells you if another board is already installed there.

The hardware testing program is designed to be run from a clean system with no TSRs or device drivers. It checks for problems in virtually every component of your hardware, from the keyboard controller through serial ports to memory chips, and can test extended memory as well as DOS.

System Sleuth's system analyzer produced generally accurate results. However, it failed to report that IRQ 10 was used by an EISA disk controller and that LaserMaster's WinJet board used IRQ 15. *WinSleuth* detected the WinJet, but no other system analyzer I tried detected the EISA disk controller's IRQ usage. The hardware tester produced accurate results but sometimes overwrote part of its screen with nonsense.

You can't get perfect results from any of the current generation of system testers, but *System Sleuth* deserves to share space in your software toolkit with the indispensable *Manifest*. ■

List Price: *System Sleuth Professional*, Version 4.0, $169. Dariana Inc., 5041 Lincoln Ave., Suite B5, Cypress, CA 90630; 800-892-9950, 714-236-1380. **Requires:** 256K RAM, DOS 2.1 or later.

CIRCLE 402 ON READER SERVICE CARD

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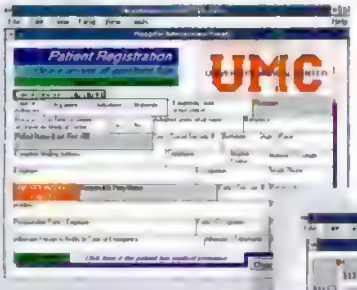

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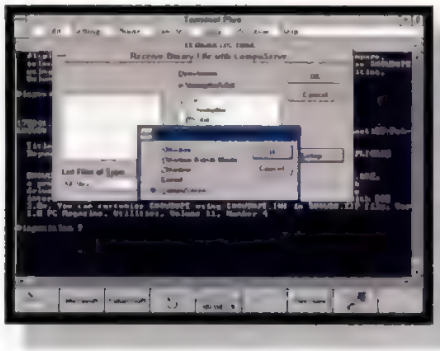
CIRCLE 285 ON READER SERVICE CARD

Terminal Plus for Windows: A Step Up from Windows' Built-in Comm Utility



Besides the ability to automate communications through scripts, *Terminal Plus for Windows* offers a wider variety of file-transfer protocols than the Terminal utility included with Windows.

HANDS ON

Following the trend of going "lite," FutureSoft has scaled down its flagship communications program for Windows 3.0, *DynaComm*, and introduced *Terminal Plus for Windows*. At $99.95, *Terminal Plus* offers a number of enhancements over the Terminal utility built into Windows. A wider choice of file-transfer protocols and the ability to automate communications sessions through scripts make it an ideal choice for Windows users who want improved communications but don't need the full scripting power and additional terminal emulations offered by packages such as *DynaComm* or *Crosstalk for Windows*.

In addition to the Kermit and XModem/CRC transfer protocols that come with Windows' Terminal, *Terminal Plus* provides the widely supported YModem/Batch and ZModem protocols as well as the CompuServe-B protocol for CompuServe (and Ziff-Net) users. *Terminal Plus* has built-in .GIF and .RLE graphics file viewers so you can view downloaded files without loading a separate program.

Terminal Plus's script language is a subset of the *DynaComm* language, containing over 200 commands to automate on-line sessions. *DynaComm* scripts will run in *Terminal Plus*. Sample scripts are included for logging onto services such as MCI Mail, CompuServe, and GEnie as well as several bulletin board services. You can set communication speeds up to 19,200 bps from the menu and up to 57,600 bps from a script. A LEARN script records actions for later inclusion in a script, and a built-in editor eases the process of creating or editing scripts.

As in Terminal, *Terminal Plus* lets you define up to four levels of commands that are linked to function keys. Unlike Terminal, though, *Terminal Plus* comes with a number of icons you can assign to the optional menu bar along the bottom of the screen. By assigning icons to dialing directories and scripts in the *Terminal Plus* Program Group, you can simply click on an icon to load a program automatically and execute a script or open a directory and dial a number.

The number of dialing directories is limited only by disk space; each one can hold up to 200 entries. The program includes predefined dialing directories that contain the settings (and in some cases the phone number) for several BBSs and on-line services. Another time-saver is the ability to import *Procomm* directories, which saves you the hassle of re-creating them from scratch.

FutureSoft offers a $99.95 upgrade from *Terminal Plus* to *DynaComm*, providing a growth path that lets you recycle any custom scripts you may have developed in its powerful yet compact cousin, *Terminal Plus for Windows*. ■

List Price: *Terminal Plus for Windows*, $99.95. **Requires:** 640K RAM (1MB recommended), 2.1MB hard disk space, Windows 3.0 or later, communications port. FutureSoft, 1001 S. Dairy Ashford, #101, Houston, TX 77077; 713-496-9400.

CIRCLE 424 ON READER SERVICE CARD

Back & Forth Task Switcher Adds Utilities

HANDS ON

The onslaught of multitasking programs such as Microsoft Windows 3.0 has not tempered interest in simpler DOS task switchers, and Progressive Solutions' newest version of *Back & Forth Professional* is helping to keep that interest alive.

With support for the DOS 5.0 Task Switcher API and a built-in screen grabber topping the list of this upgrade's modest enhancements, *Back & Forth Professional*, a shareware product, remains a strong competitor to leading commercial task switchers such as *Software Carousel*.

Unlike mulitasking programs, task switchers change programs by swapping the system image in and out of extended or expanded memory or on and off a hard disk. Once swapped out, a program managed by a switcher stops in its tracks, making it impossible to perform a feat such as downloading a file from an on-line service using *Procomm* while running *WordPerfect*.

Progressive's support for the DOS 5.0 Task Switcher's API will allow applications written to Microsoft's fledgling specification to work with *Back & Forth*. The API could help third-party developers create switcher-aware applications. For example, a version of *Crosstalk Mk.4* using the API could be forewarned that the switcher was about to swap the program out, giving *Crosstalk* the opportunity to close any sessions with the systems communications port.

Back & Forth provides a great deal of flexibility for addressing swap areas, not only in hard disk space but in XMS and EMS memory. Up to three disks can be defined, providing a great degree of flexibility. Using the Swap Definition screen, it's a snap to set up a complex swapping system using a combination of extended memory and multiple hard disk areas.

Version 2.0 installs with little modification to AUTOEXEC .BAT or CONFIG.SYS files, except for increasing the FILES= parameter to 80. When loaded in high memory, it takes only 1K.

The program can juggle up to 20 programs including conventional applications, DOS commands, and TSRs. Even programs that use EMS memory and various video modes run well.

Back & Forth comes with a collection of mini-apps, including a Rolodex and a text editor. New to Version 2.0 are a calculator and screen grabber to let you convert screen images to graphics files.

Another mini-app, Overtime!, lets you launch programs at a specific time. *Back & Forth* comes with myriad other programs, including a command line buffer for saving and recalling previous DOS commands, a macro language, and an auto-start feature for launching a group of frequently used programs when *Back & Forth* loads.

Of course, one of the most interesting things about *Back & Forth* is that you can download it from CompuServe (type GO ZENITH) and try it before you buy. For $8, you can also order an evaluation copy from Progressive Solutions.

Though not a major upgrade, Version 2.0 of *Back & Forth Professional* is a strong candidate for anyone looking for a task switcher. ■

List Price: *Back & Forth Professional*, Version 2.0, $69.95. **Requires:** 448K RAM, 1MB hard disk space, DOS 3.0 or later. Progressive Solutions, 177 E. 79th St., New York, NY 10021; 512-670-1061.

CIRCLE 423 ON READER SERVICE CARD

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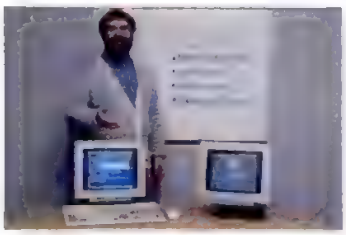

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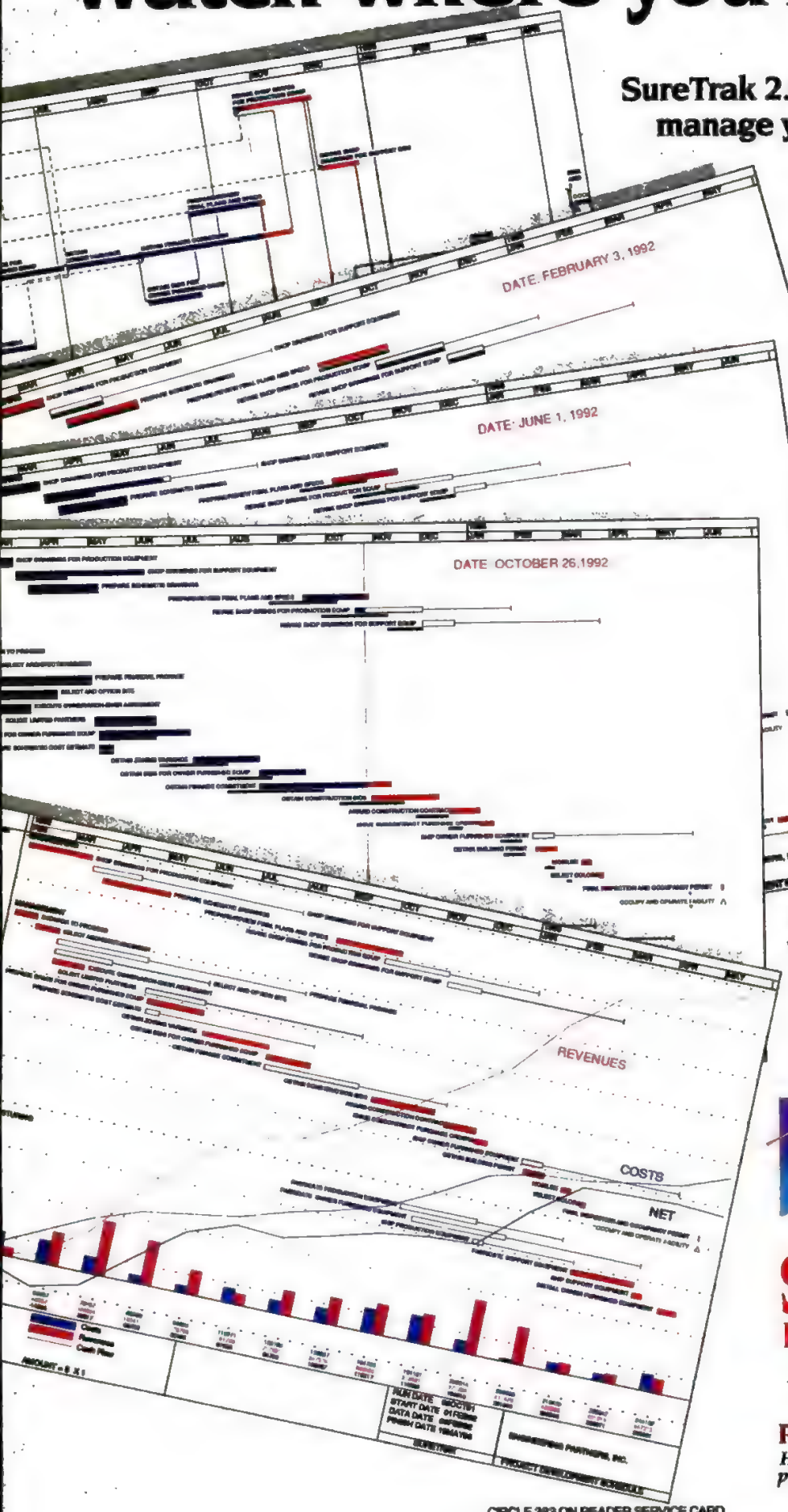
CIRCLE 398 ON READER SERVICE CARD

Watch where you're going!



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CIRCLE 383 ON READER SERVICE CARD

by Andrew Emerson Torgan

New & Improved

News of Announced Products and Upgrades

FastBack Plus Windows Backs Up In the Background

NEW **Fifth Generation Systems,** maker of the popular *FastBack Plus,* has unveiled a backup package for the Windows environment. *FastBack Plus Windows,* Version 1.0, runs in the background, backing up files while you are using other applications.

The program defaults to an Express menu upon opening and provides a list of all available source and destination drives. A "quick tag" feature lets users select the files to be backed up using mouse clicks. Data can be written to one disk drive at a time with the option of writing to any DOS device, such as removable hard disk drives and optical disks. Unformatted media is automatically formatted during the backup process.

***FastBack Plus Windows* automatically performs scheduled backups of data without interrupting running applications.**

FastBack Plus Windows offers data compression options to reduce the number of disks needed for a full backup, as well as file encryption. Fifth Generation also claims cross-platform compatibility.

List Price: *FastBack Plus Windows,* Version 1.0, $189. **Requires:** 2MB RAM, 2MB hard disk space, Windows 3.0 or later, mouse. Fifth Generation Systems Inc., 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-873-4384, 504-291-7221.

CIRCLE 405 ON READER SERVICE CARD

HOT PROSPECT

HP AND CAERE BRING NEW SCANNER AND OCR SOFTWARE TOGETHER FOR LOWER-COST SCANNING

Hewlett-Packard and **Caere** have joined forces in offering an inexpensive text- and image-scanning solution with an emphasis on productivity. Caere is offering a free trial version of its OCR package, *OmniPage Direct,* with purchase of Hewlett-Packard's new desktop scanner. The trial version of the software allows a limited number of scans—just enough to get the user hooked on OCR as an alternative method of data entry. For a limited time, users can purchase the complete version of *OmniPage Direct* for $300.

The new HP ScanJet IIp flatbed scanner recognizes 256 gray scales with an optical resolution of 300 dots per inch. Hardware and software enhancements can boost resolution to 600 dpi, according to the manufacturer. *OmniPage Direct* is Caere's optical character recognition software. It is accessible from within Windows and lets users insert scanned text directly into applications.

The ScanJet IIp supports the new application program interface imaging standard, TWAIN, letting users scan and input images without exiting an application. The scanner employs Hewlett-Packard's Accu-Page technology to monitor the brightness of page regions for optimal scans. A 20-page document feeder is a $395 option.

HP's ScanJet IIp and Caere's *OmniPage Direct* give users a taste of powerful OCR scanning at the right price.

List Price: HP ScanJet IIp, $1,295. Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900.

CIRCLE 403 ON READER SERVICE CARD

List Price: *OmniPage Direct,* Version 1.0, $595 ($300 for a limited time with purchase of HP ScanJet IIp, call 800-395-5823). Caere Corp., 100 Cooper Ct., Los Gatos, CA 95030; 408-395-7000.

CIRCLE 404 ON READER SERVICE CARD

Hypertext Creation With Eye Toward Integration

IMPROVED **Lotus** has unveiled *SmarText for Windows,* Version 2.0, which now includes SmartIcons and quick access to hypertext documents created within the package. The two-module hypertext authoring system sports a new WYSIWYG display and expanded search and linking capabilities.

SmarText's Boolean search facility consists of a fill-in-the-blank dialog box that lets users enter words, phrases, and wildcards with Boolean operators. In searching an indexed document such as a product manual, the Focus Search feature guides users to specific qualifiers by identifying index words related to the search term. A new global-linking feature links every instance of a word or phrase to a single user-defined location. Users can also zoom in on graphics for a detailed view of the image.

SmarText for Windows includes single-click access to multiple documents via its Bookshelf and has 50 SmartIcons on a customizable palette. This new version is designed to integrate with other Lotus applications for Windows and shares the same screen layout, menu bars, and SmartIcons as *Ami Pro, Freelance Graphics,* and *Lotus Notes.*

List Price: *SmarText for Windows,* Version 2.0: *SmarText Builder,* $495; *SmarText Reader,* $99. **Requires:** 1MB RAM, Windows 3.0 or later. Lotus Development Corp., Word Processing Division, 5600 Glenridge Dr., Atlanta, GA 30342; 800-831-9679.

CIRCLE 406 ON READER SERVICE CARD

ReachOut 2.1: Windows Remote Control

IMPROVED **Ocean Isle Software** is shipping a new version of its remote-control software for Windows with a host of new features and a lower price tag. *ReachOut,* Version 2.1,

CONTINUES ON PAGE 60

BRIEFS

MODEMS

Boca Research is shipping a new internal modem offering data transfer rates up to 2,400 bps. The Bocamodem 2400 Internal ($99) supports V.22 and V.22bis protocols. 407-977-6277.

Cettlan's SecureModem 2032e ($895) is a V.32 unit with callback access control and data encryption security features. The modem is designed to protect dial-in networks from unauthorized access and offers V.42 error control and MNP 5 data-compression protocols. 714-559-4016.

Microcom's QX/4232bis ($1,099) offers data transfer rates up to 57,600 bps, 2-wire dial-up operation, and supports 4-wire leased lines. The modem provides MNP 10 for optimizing data transmission under poor conditions. 617-551-1000.

Supra is now shipping the SupraFAXModem V.32bis ($399.95), offering data transfer rates up to 14,400 bps, and the SupraFAXModem V.32 ($299.95), offering data transfer rates up to 9,600 bps. Both modems feature Class 1 and Class 2 commands and are compatible with Group 3 fax machines. The units support V.42bis, MNP 2 to 5, and MNP 10 protocols. 503-967-2401.

PRINTERS AND ADD-ONS

C-Tech Electronics has unveiled the CI-8E 300-dot-per-inch desktop laser printer ($1,695), rated by the company at a maximum output of eight pages per minute. The unit features a 32-bit RISC processor, two slots for emulation, and HP-compatible font cartridges, and is PCL 5– and HP LaserJet III–compatible. 800-347-4017, 714-833-1165.

General Parametrics is shipping the new Spectra STAR Model 450 ($14,990), a RISC processor–based 300-dpi desktop thermal wax-transfer color printer with a film recorder attachment for the production of PostScript-compatible 35-mm. color slides. The existing Spectra STAR Model 440 color thermal printer can be upgraded with the SlideMaker film recorder for $6,995. 510-524-3950.

CONTINUES ON PAGE 64

CONTINUED FROM PAGE 59

includes support for EGA and SVGA displays, Windows 3.1, True Type fonts, and DOS windows within Windows.

ReachOut consists of two software packages, one for the host PC and one for the remote PC. Both are bundled in the modem version of the product. The package's file manager provides a split-screen view of both the host and remote file directories and uses compression techniques for file transfer. According to Ocean Isle, additional enhancements include expanded modem support, improved communications diagnostics and error reporting, and faster Windows performance. A network version is available. **List Price:** *ReachOut*, Version 2.1, $179 (modem version). **Requires:** 9K RAM (Windows use only) to 42K RAM (DOS or Windows use), DOS 3.1 or later. Mouse recommended. Ocean Isle Software, 80 Royal Palm Blvd., Vero Beach, FL 32960; 407-770-4777.

CIRCLE 407 ON READER SERVICE CARD

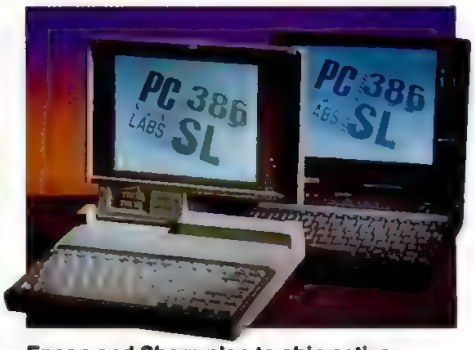
Epson and Sharp Rollout Notebooks With SL Chip

NEW **Epson** and **Sharp** are now shipping notebook PCs utilizing the power-management architecture of the 386SL processor. Both the Epson NB-SL/20 and the Sharp PC-6781 run at 20 MHz and employ performance and power-management software to extend battery life.

Epson's NB-SL/20 comes with your choice of a 40MB, 60MB, or an 80MB removable hard disk and accommodates two battery packs. The base unit ships with 2MB RAM and a 3.5-inch 1.44MB floppy disk drive, but no hard disk. With batteries as well as a hard disk on-board, the NB-SL/20 weighs in at 7.2 pounds (6.5 pounds with one battery and a hard disk). The 9.5-inch monochrome LCD displays 64 shades of gray at a resolution of 640 by 480. Epson plans to offer an active-matrix color display upgrade for the NB-SL/20 and the soon-to-be-released NB-SL/25, a 25-MHz notebook.

Sharp's PC-6781 weighs in at 4.9 pounds and has a Microsoft-compatible micro trackball built into the unit above the keyboard. External pointing devices are supported through an RS-232C serial port. The unit has a 10-inch paper-white LCD that will show 32 shades of gray at a resolution of 640 by 480. The unit has a PC card reader, letting users increase the system memory through RAM or ROM cards. The PC-6781 ships with 2MB RAM, a 3.5-inch 1.44MB floppy disk drive, and an 80MB hard disk.

Both the Epson NB-SL/20 and the Sharp PC-6781 hold the system's BIOS operating software in Flash ROM, which facilitates upgrades to future versions by floppy disk.



Epson and Sharp plan to ship active-matrix color notebooks based on the 386SL chip in the near future.

List Price: Epson NB-SL/20 (no hard disk), $2,579; 40MB hard disk, $520; 60MB hard disk, $720; 80MB hard disk, $1,020. Epson America Inc., 20770 Madrona Ave., Torrance, CA 90509-2842; 800-922-8911.

CIRCLE 408 ON READER SERVICE CARD

List Price: Sharp PC-6781, $3,799. Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430-2135; 800-321-8877.

CIRCLE 409 ON READER SERVICE CARD

E-Z Data Unveils Contact Management Solution

NEW **E-Z Data** is shipping *SmartOffice*, Version 1.0, which offers a fully customizable client database and telemarketing scripts. The contact management package also includes a word processor, a report generator, and a notepad feature that logs the date and description of contact-related activities as well as general notes.

In the database, field length, type, position, and the number of fields per entry are all user-definable. Second-level records are created to fit individual needs. The client information records also contain user-definable fields to optimize the search process. *SmartOffice*'s telemarketing features include customizable scripts, auto-dialing, and a phone log. **List Price:** *SmartOffice*, Version 1.0, $395; two-node network version, $595. **Requires:** 450K RAM, 2MB hard disk space, DOS 2.1 or later. E-Z Data Inc., 533 S. Atlantic Blvd., Monterey Park, CA 91754; 800-777-9188, 818-281-7640.

CIRCLE 410 ON READER SERVICE CARD

Tecmar Releases Full-Motion TV System For the IBM PS/1

NEW **Tecmar** is shipping Vision/1, an adapter unit that enables the IBM PS/1 to display full-motion color video from standard broadcast or cable television, VCRs, video cameras,

CONTINUES ON PAGE 64

"POWER BEYOND YOUR DREAMS."

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Intel486™ 33MHz » 8MB RAM » 256K Cache » Teac 1.2MB & 1.44MB FDD » Quantum 240MB IDE HDD w/64K DisCache® buffer (15ms) » 15" NEC 4FG Super VGA flat square screen monitor (1024x768) » Orchid Pro-IIs SVGA card w/1MB » 2 serial, 1 parallel, & 1 game port » 101 key keyboard » Windows 3.0 » DOS 5.0 » Hi-Res Mouse » 1yr. TRW on-site service. **$3,895**

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CIRCLE 360 ON READER SERVICE CARD

All the benefits of a laser printer

A size

DESKTOP CONVENIENCE

RELIABILITY

LOW COST

SHARP, HIGH QUALITY OUTPUT

FAST PRINTING SPEED

PLAIN PAPER

At last. A personal output device that combines the best features of a desktop laser printer with the ability to produce large C-size drawings. It's called ProTracer — a monochrome ink jet printer/plotter designed for the personal use of PC CAD professionals.

MEDIA FLEXIBILITY

ProTracer is a desktop printer/plotter that lets you produce A, B, as well as large C-size output. It prints sharp, precise lines on a variety of media including plain and bond paper, plotter paper, and vellum.

SPEED

ProTracer is fast and quiet because it uses the latest inkjet technology and an Intel i960 processor. Just compare it to any other large format plotter and you'll see. A complex C-size drawing often takes over half an hour on a pen plotter, while ProTracer completes the same drawing in only five minutes!

HIGH QUALITY OUTPUT

ProTracer achieves its high quality output by utilizing a 64 nozzle printhead to deliver crisp lines and bold, high contrast blacks. Its 360 dpi resolution assures sharp lines needed for everything from the most complex engineering drawings to sophisticated text and graphics used in letters and reports.

VERSATILE AND EXPANDABLE

Unlike other large format devices, ProTracer isn't limited to plotting. Instead, it can produce high quality finished output for a variety of

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On a much larger scale.

C size

applications including word processing, spreadsheets, and desktop publishing. Start with the ProTracer base unit that incorporates resident IBM ProPrinter and Epson LQ-1050 emulations, as well as an ADI plotter driver for AutoCAD users. Then, depending on your needs, choose from a variety of easily installable upgrades and accessories including HP-GL and PostScript® language emulations, and memory.

Optional Printer Accessories

HP-GL emulation card	$399
PostScript language emulation card	$499
2 MB memory upgrade	$299
8 MB memory upgrade	$899
Sheet feeder I (100 sheet)	$149
Sheet feeder II * (100 sheet)	$129
PacificTalk (AppleTalk interface module)	$199

*Sheet feeder is required for use

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If you'd like to expand your personal printing and plotting capabilities, call Pacific Data Products at (619) 597-4648, Fax (619) 552-0889.

$1499

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BRIEFS

CONTINUED FROM PAGE 60

Star Micronics has unveiled a 4-pound portable ink jet printer. The StarJet SJ-48 ($499) runs off AC power or an optional rechargeable battery pack. The company rates the unit as capable of 40 pages of printing on a single charge. 800-447-4700.

Excellink has unveiled the JetCard/DJ ($995), a multiuser interface that allows buffered sharing of Hewlett-Packard's HP DesignJet plotter for up to seven users. The JetCard/DJ ships with 2MB RAM or buffer memory, expandable to 4MB. 408-295-9000.

OCTuS is shipping the PDL-Net 550 ($3,495), a single-port network printer-server card for *NetWare* networks. The unit's software offers PCL 4, PCL 5, PostScript, TrueImage, and HPGL plotter page description languages. The PDL-NET 650 ($4,495) is a two-port version. 619-452-9400.

Western Telematic's Lasernet Model PSU-41 BP printer-sharing unit ($295) accommodates up to four PCs or workstations and one printing or plotting device. The unit comes with 256K RAM or buffer memory, expandable to 4MB using SIMMs. 800-854-7226, 714-586-9950.

GCC Technologies is shipping *PLP*, Version 4.0 ($69), which will add background printing capabilities to its line of PLP II series of laser printers. 800-422-7777.

Lazy Dog Foundry is offering two collections of custom Type 1 PostScript hand-drawn typefaces in the publishing and advertising styles of the 1920s and 1930s. The basic set of 84 typefaces is priced at $179. The complete set of 150 typefaces costs $350. 800-875-9807, 612-774-4717.

DATABASES

Custom Computing Solutions is now shipping *The Client Database*, Version 4.1 ($295). The package offers up to ten user-defined fields and stores records for up to 99,999 clients. Additional features include mail-merge and macro creation. 613-830-3846.

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and laser disk players.

The Vision/1 can display color video input in VGA mode either occupying the full screen or in a small movable window. Users can execute software applications while the Vision/1 display is open. The unit requires a PS/1 and performs independently of the operating system, requiring no additional software. **List Price:** Vision/1, $395. **Requires:** IBM PS/1. Tecmar, 6225 Cochran Rd., Solon, OH 44139-3377; 800-624-8560, 216-349-1009.

CIRCLE 412 ON READER SERVICE CARD

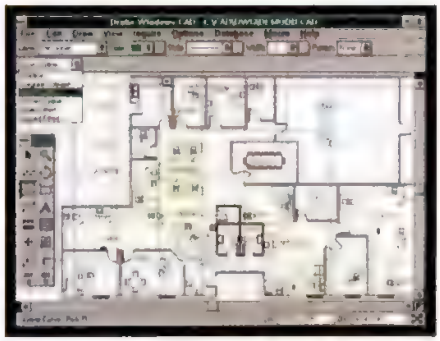
New Drafix Windows CAD Boasts up to 100 Percent Faster Redraw

IMPROVED **Foresight Resources** has unveiled a new user interface that includes an icon toolbox and a CAD edit bar with its release of *Drafix Windows CAD*, Version 2.0. The latest version contains a host of new features and offers 50 to 100 percent performance gains for redraw and entity picking, according to the company.

The CAD edit bar displays all the geometric information of any user-selected drawing or of the last item drawn. The properties of the drawing can be altered by entering new geometric values. A new "intelligent cursor" feature lets the user know which snap mode is selected and what input the system expects next. The cursor informs the user that endpoints or midpoints must be selected next, or to change snap modes. The icon toolbox offers access to over 100 drawing, editing, and viewing commands. The icons are resizable.

Drafix Windows CAD also has an enhanced macro language, over 50 sample macros, and a macro editor. The new version now supports dynamic data exchange (DDE) with *Microsoft Excel*.

List Price: *Drafix Windows CAD*, Version 2.0, $695; upgrade from *Drafix Windows CAD*, Version 1.1, $145. **Requires:** 2MB RAM (4MB recommended), 4MB hard disk space, Windows 3.0 or later. Mouse, math coprocessor recommended. Foresight Resources Corp., 10725 Ambassador Dr., Kansas City, MO 64153; 800-231-8574, 816-891-1040.



***Drafix Windows CAD* has a new interface with a movable icon toolbox, and promises faster redraw performance for redraw and entity picking.**

CIRCLE 413 ON READER SERVICE CARD

Fax Data to Your PC with TeleForm

NEW **Cardiff Software** has unveiled a new approach for data collection that lets virtually any fax machine function as a remote data entry terminal. *TeleForm*, Version 1.0, a Windows application, lets users create an unlimited number of coded forms for hand-printed or check-box information that can be faxed to remote sites. Completed forms are faxed back and automatically routed to the appropriate database or spreadsheet application.

The package consists of three modules. The forms creation module lets users design and code individual forms. The data administration module tracks the destination of faxed forms and can be set to fax out a reminder fax if a specified time elapses before the return of the original form. The forms interpretation module reads the coded form upon receipt and writes the information to a file.

TeleForm works with any Group 3 fax machine and exports collected data to database and spreadsheet applications such as *dBASE*, *Paradox*, *Microsoft Excel*, and *Lotus 1-2-3*. The package also supports dynamic data exchange (DDE) with Windows applications. **List Price:** *TeleForm*, Version 1.0, $995. **Requires:** 4MB RAM, 40MB hard disk space, Windows 3.0 or later, supported fax board, mouse. Cardiff Software Inc., Stevens Ave., Bldg. B, Solana Beach, CA 92075; 619-481-2255.

CIRCLE 414 ON READER SERVICE CARD

Spice Up Your Documents with TextAppeal

NEW **Power Up! Software** is now shipping *TextAppeal for Windows*, Version 1.0, a type-styling package that lets users create corporate logos and custom headlines and add starbursts and other text effects to Windows documents. It offers predefined shapes, type manipulation, drawing tools, and graphics file import and export features.

TextAppeal can curve, rotate, and stretch type and apply shadow effects. Drawing tools include line, box, circle, polygon, Bezier curve, and starburst. Fifty predefined custom tools can be modified, and users can create and save new tools to the palette. The package supports the Windows Clipboard, and CGM, .PCX, and TIFF graphics file formats. *TextAppeal* works with most Windows word processing, desktop

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Acer believes there is room for a different kind of computer company. One that not only offers everything from entry level PCs to 200 person UNIX™ networks, but designs them to grow when you do. Advance when technology does. And work as hard for your money as you do.

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CIRCLE 091 ON READER SERVICE CARD

BRIEFS

CONTINUED FROM PAGE 64

MySoftware is offering *MyDatabase* ($24.95), Version 1.0. The program includes ten predefined templates for records, such as customer contacts and product orders. 415-325-9372.

IMAGE PROCESSING

Application Techniques has unveiled *CaptureEze*, Version 1.0 ($59), a new screen-capture utility for Windows. The utility lets users capture the entire screen or a selected portion, such as an active window. *PictureEze*, Version 2.0 ($149), is an upgrade of the company's Windows graphics file format converter and now ships bundled with *CaptureEze* at no additional cost. 508-433-5201.

Digital Vision is shipping *CineMaker* for its ComputerEyes/RT 24-bit color video digitizer. *CineMaker* captures animations in resolutions up to 256 by 200 at up to 18 frames per second. *Hicolor Support* captures Hicolor images for display with popular graphics cards such as ATI's VGA Wonder XL and Everex's True Color. Both are bundled free with ComputerEyes/RT, or can be downloaded free from the Digital Vision Hot Line BBS (617-329-8387) or from the CompuServe forum (GO GIGVIS). 617-329-5400.

Handmade Software's image conversion and compression package, *Image Alchemy*, Version 1.5 ($79.95), supports up to 36 file formats and provides JPEG file compression for storing high-resolution color images. The package offers image resizing, color optimization, color mapping to shades of gray, and dithering algorithms. 408-358-1292.

North Coast Software is shipping a new 24-bit true-color bitmap conversion package for Windows. *Conversion Artist*, Version 1.0 ($149.95), imports over 20 graphics file formats for conversion and exports to over 15 formats. It converts Windows metafiles to scalable bitmapped images and supports cross-platform conversions to Amiga, Macintosh, SUN, Silicon Graphics, and OS/2. It provides a screen-capture utility and offers color reduction and file compression. 603-332-9363.

CONTINUED FROM PAGE 64

publishing, and presentation graphics applications.

List Price: *TextAppeal for Windows*, Version 1.0, $129.95. **Requires:** 2MB RAM, 3MB hard disk space, Windows 3.0 or later. Power Up! Software Corp., 2929 Campus Dr., San Mateo, CA 94403; 800-851-2917, 415-345-5900.

CIRCLE 415 ON READER SERVICE CARD

Qwiknet Triples Data Capacity, Speeds Scheduling

IMPROVED **Project Software & Development** is shipping an extended-memory version of its project management software program. *Qwiknet Professional*, Version 3.0, offers scheduling features that are five times as fast as those in previous releases of the program, according to the company.

In addition to the performance gain, extended-memory support enables *Qwiknet* to triple its data capacity, allowing multiproject scheduling and up to 16,000 activities per project. Additional enhancements include the ability to save user defaults, new sorting and selecting capabilities, and multiproject retrieve, save, and cancel options that speed the process of project retrieval.

List Price: *Qwiknet Professional*, Version 3.0, $2,500. **Requires:** 640K RAM, 2MB extended memory, DOS 3.1 or later. Project Software & Development Inc., 20 University Rd., Cambridge, MA 02138; 800-366-7734, 617-661-1444.

CIRCLE 416 ON READER SERVICE CARD

Pilot Unveils LightShip 3.0 and LightShip Lens

IMPROVED **Pilot Software**'s executive information system (EIS) for Windows, *LightShip*, Version 3.0, now offers enhanced data access and presentation. A new add-on package, *LightShip Lens*, supports dynamic data exchange (DDE) with other Pilot software programs and lets users create dynamic link libraries (DLLs) to access programs that do not support DDE.

The program's graphical interface now includes cascading menus and a more streamlined structure. The screen display now supports up to 256 colors. Mouse support and charting features enhance the multidimensional data-manipulation capabilities, which include summaries, tables, and calculations.

List Price: *LightShip*, Version 3.0, $795; *LightShip Lens*, $195. **Requires:** 2MB RAM, Windows 3.0 or later (*LightShip Lens* requires *LightShip*, Version 3.0). Pilot Software Inc., 40 Broad St., Boston, MA 02109; 800-944-0094, 617-350-7035.

CIRCLE 417 ON READER SERVICE CARD

Drag and Drop Printing on the Way For Windows

NEW **Non-Causal Systems** is shipping a text formatting and printing utility with a drag-and-drop feature that will be functional under Windows, Version 3.1. *Causality for Windows*, Version 1.0, lets users surpass the Windows notepad and format and print text files with a variety of user-defined options.

The program offers file grouping and file filtering as well as sorting, copying, and a file viewer. According to Non-Causal Systems, the drag-and-drop feature will allow users to select a file from the File Manager and drop it on *Causality for Windows'* icon.

List Price: *Causality for Windows*, Version 1.0, $79. **Requires:** 512K RAM, Windows 3.0 or later. Non-Causal Systems Inc., 4691 N. University Dr., #384, Coral Springs, FL 33067; 800-221-9423, 305-345-9656.

CIRCLE 418 ON READER SERVICE CARD

Pointing Devices Add Functionality

IMPROVED **Logitech** and **MicroTouch** are offering two stationary alternatives to the traditional mouse. Logitech's new nautilus-shaped TrackMan has been designed to provide a comfortable resting platform for the right hand. The trackball sits below the thumb.

MicroTouch's PC UnMouse, a touch tablet pointing device that offers cursor control with the touch of a finger, includes *Power KeyPad* software for programming macro commands to areas of the touchpad surface. ■

List Price: Logitech TrackMan, $139. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500.

CIRCLE 419 ON READER SERVICE CARD

List Price: MicroTouch PC UnMouse with *Power KeyPad*, $199. MicroTouch Systems Inc., 55 Jonspin Rd., Wilmington, MA 01887; 508-694-9900.

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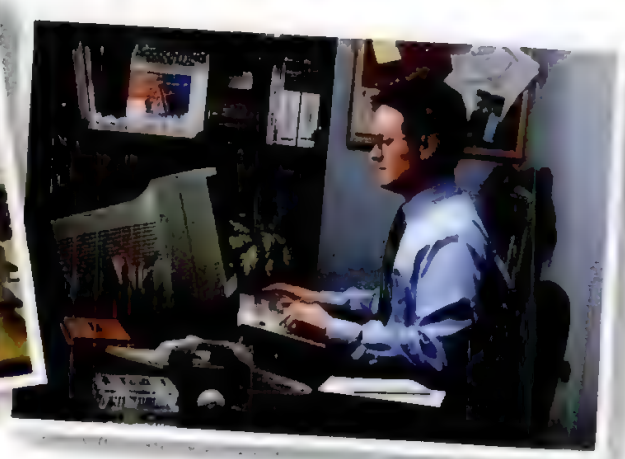
When a minimum of desktop real estate is available, these alternative pointing devices provide full cursor control.

Take The Money And Run!



Take the Money With All NEW! DacEasy® Point of Sale™

New DacEasy Point of Sale is the perfect stand-alone point of sale system for every size business that also integrates fully with DacEasy Accounting 4.2! New Point of Sale turns any 286 or better PC into a powerful Point of Sale system and it's compatible with PC-Based point of sale hardware, too.

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Integrate With DacEasy Accounting 4.2!

Best of all, DacEasy Point of Sale can integrate with DacEasy Accounting to provide complete inventory management and streamline your accounting activities! Use them together and you'll find there's no better way to take the money *and* run your business.

Run Your Business Easily With DacEasy® Accounting™ 4.2

Over one million businesses have learned the advantages of using DacEasy Accounting to manage their books. Its 12 integrated modules make running your business easier than ever: General Ledger, Accounts Receivable, Accounts Payable, Cash Management, Inventory, Product Assembly, Purchase Order, Billing, Budgeting, Graphics, Forecasting, and Report Generator. Use all of the modules or just the ones you need. Either way it's your total business solution.

Friendly Accounting.

DacEasy's logical interface and complete on-line, context sensitive help make it easy to learn and use. And the simple point-and-shoot mouse environment with transaction-oriented, pull-down menus is friendly to even the most novice of users.

Powerful Accounting.

With a complete report generator and 3-D graphics capability, DacEasy Accounting has your business covered with critical information at your fingertips. And printing Invoices, Purchase Orders, Statements, Credit Memos and other forms are a keystroke away.

The Most Award-Winning Accounting.

Over the past six years, DacEasy has won more awards than all other Accounting software combined. Plus, we're proud of having the industry's largest support staff and quality DacEasy Certified Consultants nationwide, all professionally trained to provide complete support should *you* ever need it.

Unmatched Value.

Nothing matches DacEasy's combination of power, simplicity and value. Add DacEasy Point of Sale to the equation and running your business will be easier than you ever imagined.

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Network Versions Also Available

Network versions of DacEasy Accounting and Point of Sale are also available for just $299.95 each, or check out the special network offers in the single-user packages! These NetBIOS compatible systems have the same features as the single user versions but allow unlimited access with multiple PCs - just think of the possibilities!

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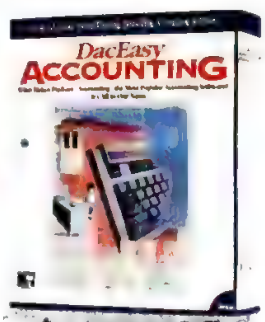
Media Code: PCM

Requires: 640K, IBM or compatibles or PC based Point of Sale System. Hard disk, DOS 3.1 or later, mouse optional. Network versions require NetBIOS compatible LAN. DacEasy, DacEasy Accounting and Point of Sale are trademarks of DacEasy, Inc. Copyright © 1992 All Rights reserved

CIRCLE 022 ON READER SERVICE CARD



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If you need any more power than this

If your desire for power is on the scale of say, Louis XIV, consider the Toshiba T2200SX. Weighing a mere 5.5 pounds and taking up just half a briefcase, it possesses an awesome 20 MHz 386SX microprocessor and a 40, 60 or 80 MB hard drive with 2MB RAM expandable to 10 MB. And it's powerful enough to have grabbed both a PC/Computing MVP award and a PC Magazine Technical Excellence Award.

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The new T3300SL

maybe you should get into politics.

If your need for power is on the scale of say, Napoleon, consider the new T3300SL. It offers a 25MHz 386SL microprocessor plus 64 KB cache for blazing speed and longer battery life. Not to mention an 80 or 120MB drive and a PCMCIA-compatible slot. And like its cousin the T2200SX, it offers a Nickel Hydride battery and a carbon-fiber reinforced case. So call 1-800-457-7777. Or if you want even more power, don't forget it's an election year.

In Touch with Tomorrow
TOSHIBA

CIRCLE 379 ON READER SERVICE CARD

Paying again and again for virus protection is enough to make you ill.

Frankly, paying anything at all is pretty nauseating.

But that's nothing compared to the feeling you get in your stomach when a drive full of data goes down the drain.

So you pay.

Then you pay again. For upgrades. Or quarterly "updates."

But even that doesn't buy you much peace of mind. Because each new day brings an average of six new viruses into the world.

Which means all anti-virus programs are inherently obsolete.

Except one.

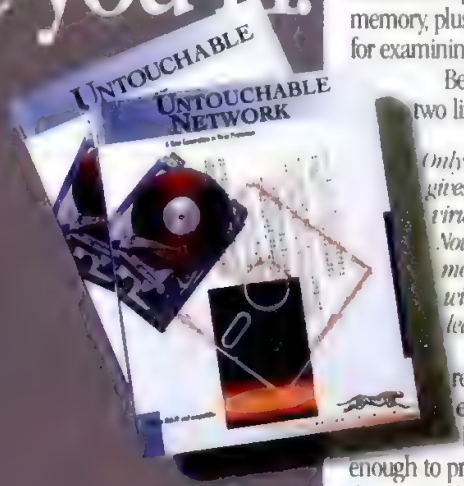
Introducing Untouchable.™ The only software in the world that gives you 100% protection.

Today.

And tomorrow.

Like other anti-virus software, Untouchable is equipped with a TSR monitor for patroling your system memory, plus a scanner/remover for examining the files on your disk.

Between them, these first two lines of defense can recognize and obliterate hundreds of the little buggers — enough to protect you from 95% of the potential carnage.



Only Untouchable Network gives you centralized virus protection. Now you can install, monitor and control without having to leave your seat.

If you find that statistic reassuring, then you probably like the odds in Russian Roulette.

If you don't, you'll want to know that Untouchable is equipped with a unique *third* line of defense, which has been mathematically proven to be, well, untouchable.

Instead of looking for viruses, this third line of defense looks for *changes in your executable and system files.*

If the change is but a single byte, Untouchable will spot it and, using our patent-pending recovery technique, reconstruct the file to its original state.

The process is known as Generic Differential Detection, and certain other programs claim to perform it, too.

But only Untouchable calculates file signatures using not one, but two proprietary algorithms that can't be reverse-engineered.

Only Untouchable guarantees 100% safe recovery of infected files. (Unlike other programs that proudly generate corrupted files, Untouchable knows when the jig is up and doesn't attempt recovery.)

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CIRCLE 288 ON READER SERVICE CARD

edited by
Carol Levin

Read Only

Reviews of the Latest Books for the PC User

Parent's Handbook Rises Above The Hype, Gets Kids Computing

As if parenting were not hard enough, now we're asked to contend with computers for our kids. Grown-ups who feel right at home with *Lotus 1-2-3* macros or SQL query formats still get anxiety attacks when trying to decide what sort of computers and programs to get for their children to use at home. And for parents who aren't familiar with computers, the problem is that much worse.

Help has arrived. *Kids & Computers: A Parent's Handbook* by Judy Salpeter leads parents through the home-computing jungle, while its companion book, *The Ultimate Collection of Computer Facts and Fun*, helps kids understand computers.

Kids & Computers is an attractive and accessible book, with punchy chapters filled with helpful advice and insights. Opening with a realistic view of what kids should know about computers, the book steers clear of the hysteria and hype often associated with this topic. The remaining chapters cover topics such as how to work with your child at the computer, what to encourage, at what age to start him, and how to coordinate home computing with school instruction.

In spite of the dense content, Salpeter's writing style is light and entertaining, and each chapter opens with an anxiety-diffusing cartoon from "The 5th Wave" by Rich Tennant (creator of the illustrations in *PC Magazine*'s Abort, Retry, Fail?).

The second half of *Kids & Computers* contains lucid reviews of dozens of education and entertainment software titles that Salpeter feels are exemplary. She provides not only a good description of how each program works, but also points out strengths and weaknesses and includes a color screenshot of each program. Whether you have a computer at home or not, you can still help your kids answer the question "How does a computer work?" with *The Ultimate Collection of Computer Facts and Fun* by Cindra Tison and Mary Jo Woodside. This colorful book uses snazzy graphics and short items to grab and hold young readers' attention. It's filled with games, puzzles, and exercises that illustrate different aspects of computing and poses lots of intriguing questions that can serve as jumping-off points for discussions with your child.

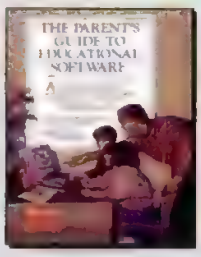
If you're puzzling over the right software for your kid's PC, or you want an easy answer for parents at parties who pump you for advice since you know something about computers, you'll want to check out both of these books. It's great to know we don't have to struggle through this on our own.—*Alfred Poor*

Kids & Computers: A Parent's Handbook
by Judy Salpeter, $16.95. ISBN: 0-672-30144-X.

The Ultimate Collection of Computer Facts and Fun
by Cindra Tison and Mary Jo Woodside, $12.95, SAMS, Prentice Hall Computer Publishing, 11711 N. College, Carmel, IN 46032; 800-428-5331, 317-573-2500. ISBN: 0-672-30093-1.

CIRCLE 456 ON READER SERVICE CARD

Shopping for Kids' Software



If you're wondering what software you should get your middle-school student to help with prealgebra or what to get your fourth grader for spelling, there's a book that will lead you directly and skillfully to the top choices. *The Parent's Guide to Educational Software* (Microsoft Press, $14.95, 800-677-7377, 206-882-8080) evaluates more than 200 carefully selected titles. The informative and well-written evaluations list equipment requirements and curriculum objectives and point out strong and weak points. It also supplies practical background information, including a table that cross-references each program by subject area and grade level, and gives advice on how to evaluate programs and how to set up a computer in your home.—*A.P.*

Winn L. Rosch: Don't Upgrade Without Him

PCs are a collection of a la carte, yet interrelated, hardware components. As better components become available or affordable and your computing needs change, you're going to want to upgrade your PC. The first step to take before you upgrade is to get *The Winn L. Rosch PC Upgrade Bible*. Not to be confused with *The Winn L. Rosch Hardware Bible*, *The PC Upgrade Bible* includes material from Rosch's monthly column, Upgrade Clinic, which appears in *PC Sources* magazine.

The Latin poet Horace once wrote, "The secret of all good writing is sound judgment." This trait is evident throughout *The PC Upgrade Bible*. Rosch, an eminent PC journalist with extensive PC hardware experience, carefully weighs the price-to-performance ratios of his upgrade recommendations, always keeping the reader's pocketbook in mind. His witty, tongue-in-check writing style keeps the reader alert through his tour of the PC hardware maze. Illuminating the text are quality illustrations by Bruce Sanders, who illustrates Rosch's Upgrade Clinic column.

Rosch begins with an overview of system bottlenecks and strategies for improving PC performance. He details a variety of no-cost and low-cost DOS and hardware fixes to help you get the most from existing hardware and devotes the rest of the book to explaining the wide range of upgrade options, from changing microprocessors to adding a backup power system. Rosch explains how to upgrade memory, disks (including optical disk drives), ports and modems, graphics adapters, monitors, input devices, and tape systems. While the book's emphasis is on hardware, it also includes many software solutions.

Although the *PC Upgrade Bible* is comprehensive, it isn't all-encompassing: The book doesn't include a Windows user's perspective toward upgrading. Rosch also does not cover video hardware accelerators for Win-

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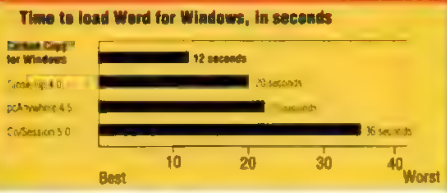

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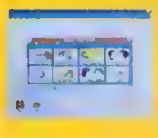

"Carbon Copy for Windows is the closest thing to having remote control built into Windows itself." *Windows Magazine*

"It [Carbon Copy for Windows] gets my award as the best Windows program of the year..." *PC User*

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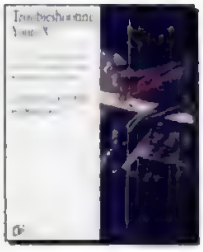
CIRCLE 339 ON READER SERVICE CARD

dows, such as those graphics cards based on the S^3 86C911 or Weitek W5086 chips. And when covering software-based screen and keyboard accelerators, he does not mention that they have no effect on Windows' performance. The book could also use more hands-on upgrading examples, such as changing ST506 and SCSI disk drive terminators.

In spite of some minor sins of omission, *The Winn L. Rosch PC Upgrade Bible* is packed with valuable information that's sure to save you time and money. Don't upgrade without it.—*David Angell and Brent Heslop*

The Winn L. Rosch PC Upgrade Bible
by Winn L. Rosch, $26.95, Brady Publishing, Simon and Schuster Inc., 15 Columbus Circle, New York, NY 10023; 800-624-0023, 212-373-8093. ISBN: 0-13-932252-3.
CIRCLE 457 ON READER SERVICE CARD

PC Fix-It Guide to the Rescue When PC Emergencies Strike



Your computer crashes at 3 o'clock on Sunday afternoon as you're putting the finishing touches on the presentation you have to give on Monday morning. It's after hours; there's no tech support. It's just you and your PC.

Every PC user has encountered some PC emergency or another. To help you respond to such seemingly insurmountable problems, the trio of Jim Aspinwall, Rory Burke, and Mike Todd has produced *Troubleshooting Your PC*, a highly readable, organized, and effective guide.

Reading like the phone log of a tech-support hot line, this 496-page guide to troubleshooting dysfunctional hardware and software identifies 136 key problems—from configuring a system, to dealing with printers, to using diagnostics software.

The authors offer a problem-oriented approach that breaks down broad topics into specific problems and solutions. For example, the Problem Index lists a chapter on serial communications with 22 specific problems. If your modem dials out, but nothing else happens, then turn to page 239 where the problem is laid out in a direct format: Symptom, Suspect, and Solution. All the material is supported by capable technical information that's neither intimidating nor superficial, and an instructive tone is maintained throughout the book.

Troubleshooting Your PC is not restricted to the 136 named problems. A number of technical troubles are revealed and resolved throughout the troubleshooting narrative, but the book does not cover enough of them. The authors devote considerable space to communications and even cross-platform file transfer, but offer virtually no advice for LAN trouble and only brief coverage of Microsoft Windows troubles.

Thankfully, they do cover important hardware and software incompatibility issues and devote just under a third of the book to a technical reference, glossary, and index that are loaded with useful cabling diagrams, IRQ assignments, keyboard functions, memory maps, and video charts.

While no one book can treat every PC ailment, *Troubleshooting Your PC* is a well-designed and executed resource for tackling most troubles encountered in computing.—*Greg Pastrick*

Troubleshooting Your PC
by Jim Aspinwall, Rory Burke, and Mike Todd, $26.95, M&T Books, 411 Borel Ave., #100, San Mateo, CA 94402-3522; 800-533-4372, 800-356-2002. ISBN: 1-55851-224-1.
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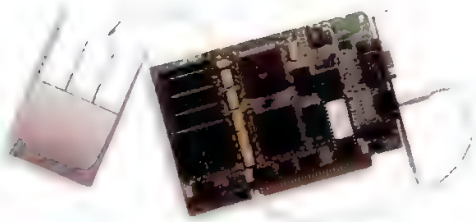

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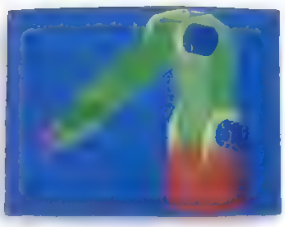

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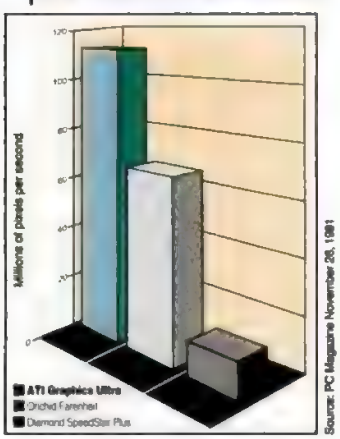

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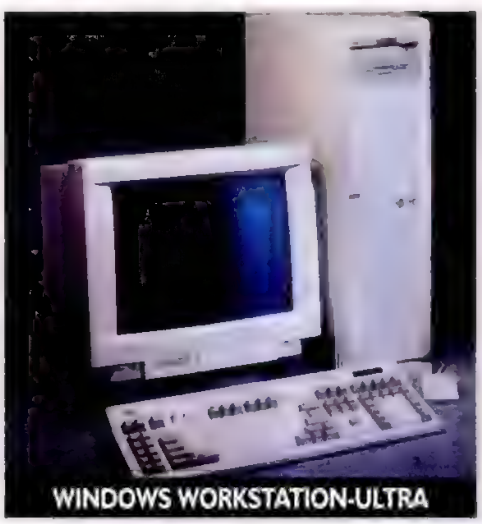

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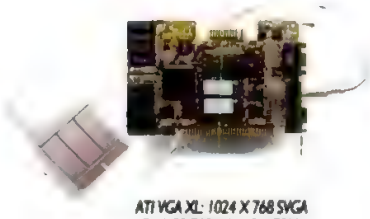

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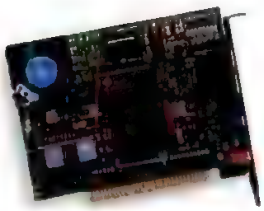

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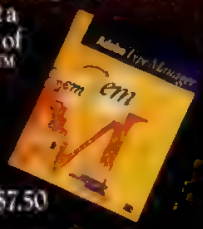

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CIRCLE 353 ON READER SERVICE CARD

edited by
Trudy Neuhaus

Toolkits

Reviews of the Latest Tools for the PC Programmer

ObjectGraphics Simplifies Windows Graphics Programming in TPW and BC++

Borland International's Object Windows Library (OWL) wraps the sharp-edged Windows API (application program interface) functions in an object-oriented comfort layer, making Windows programming both easier and faster. Now ObjectGraphics, from the Whitewater Group, does the same for the Windows GDI (Graphics Device Interface) functions. Available for both Turbo Pascal for Windows and Borland C++, this library of objects greatly simplifies the process of displaying and manipulating graphics in Windows applications, and obviates the need for any direct calls to the GDI primitives.

Objects in ObjectGraphics extend the functionality of the basic OWL objects; they're all part of the same hierarchy. Where a straight OWL program would use a TWindow object for its main window, an ObjectGraphics program uses a TGWindow object (a TWindow descendant with specific support for graphics built in). The ObjectGraphics manual categorizes TGWindow as a *platform filter*, along with objects that represent printers, output devices, and colors. An ObjectGraphics program can use the same code to draw a graphics object on-screen, print it on the printer, or add it to an image contained in a bitmapped object.

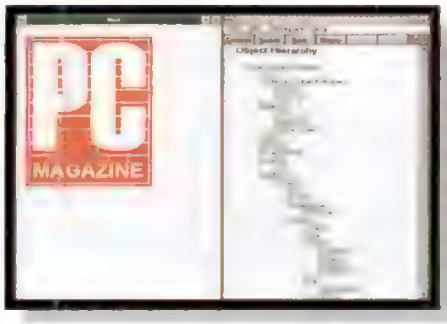
The remaining ObjectGraphics objects fall into the categories of rendering tools and graphics objects. The TPen and TBrush rendering tools represent the corresponding Windows elements, and a TTextPen object bundles together attributes like font, size, color, and style, used by graphics objects that draw text. TGraphSpace objects handle coordinate systems, axis mapping, and zooming, and are associated with output devices.

The GDI has built-in functions to draw many common shapes, such as lines, rectangles, ellipses, pie slices, arcs, and polygons. All of these become graphics objects in ObjectGraphics, along with a wide variety of more complex graphics. A TBezier object defines a Bezier curve, a TPolyMark serves to mark the corners of another object's bounding rectangle, and a TRichText holds a collection of text strings with different fonts, styles, and colors, just to name a few. The important TPicture object is a collection that holds other graphics objects (including other TPictures); every TGWindow uses a TPicture field called Picture to track the objects it displays.

Windows itself provides no single function to load and save bitmap files to disk; the TGBitMap object fills this void. A scrolling bitmap demo supplied with TPW itself used twice as many lines of code as a near-identical ObjectGraphics program. And a TGBitmap can masquerade as an output device, allowing you to "draw" graphics objects on it.

Here's a little example to show the difference ObjectGraphics makes. Suppose a program needs to display a rectangle on-screen with a blue border and a red cross-hatched interior. Without ObjectGraphics, this requires 11 Windows function calls; 5 to set up for drawing, 1 to draw the rectangle, and 5 to clean up afterward. (If you omit any of the clean-up function calls, your program will gradually eat away at the Windows system resources.) Using ObjectGraphics, you'd simply create a TRectangle object, change its Pen field to a blue pen and its Brush field to a red cross-hatched brush, and add it to the main window's Picture. That's all; every shape in the Picture collection gets drawn on-screen automatically.

It's common for a Windows program to let the user drag objects around the screen using the mouse. ObjectGraphics meets this need with TGWindow's virtual methods BeginDrag, Drag, and EndDrag, meant to be overridden to provide a program's specific dragging behavior. The figure below shows an ObjectGraphics-based program I wrote that displays the *PC Magazine* logo and lets the user drag it around the screen. I found it quite easy to write the code that drags an outline of the logo across the window. Drawing the logo itself was more of a chore; ObjectGraphics doesn't provide a font with the right aspect ratio for the *P* and *C*, so I had to construct those characters from rectangles and pie wedges.



In this ObjectGraphics program, the *PC Magazine* logo is being dragged across the screen in outline form; the Help utility shows up on the right side of the screen.

ObjectGraphics defines a file format based on the OWL TStream object. An .OGL file contains a header, a TGraphSpace object, and a TPicture. Any ObjectGraphics-based program can read and write these files, and the package includes full source code for the sample program ObjectDraw, which lets you "paint" with objects and save the result to an .OGL file. ObjectDraw does have a few limitations: The indispensable Undo function is absent, and placement of objects on the screen is strictly "by eye," with no status line report of cursor location.

The ObjectGraphics documentation consists of a manual and a Windows-style help utility, and the two hardly overlap. That's unfortunate; important topics such as the list of fields and methods for each object don't appear in print. You'll want to keep the help utility running any time you're using ObjectGraphics.

Not every TPW or BC++ programmer needs ObjectGraphics; it won't be much use in an MDI-based text editor, for example. Still, any Windows program that displays graphics will benefit from the .OGL objects, and writing interactive graphics programs will be vastly easier with this useful toolkit.

—*Neil J. Rubenking* ■

ObjectGraphics

List Price: $195; with source code, $390. TPW and Borland C++ versions sold separately. **Requires:** Windows 3.0, Turbo Pascal for Windows or Borland C++, Object Windows Library (OWL). The Whitewater Group, 1800 Ridge Ave., Evanston, IL 60201; 800-869-1144, 708-328-3800.

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Michael J. Miller

The Best Application For You

Tomorrow's perfect software may not be one killer app, but a quick way to join and use the desired features of several apps at once.

In the 1980s, we spent much of our time looking for applications that had new and better features. Now we just assume that the features will be there. Tomorrow we'll be looking for the applications and the interfaces that work best for us.

More and more, different kinds of applications are beginning to share the same types of tools. For years now, word processors have come with spell-checkers. Now, so do all of the major presentation graphics programs, because no one wants to display a slide in foot-high type that has a word misspelled. Next you'll see spell-checkers added to spreadsheets.

The same process is happening with graphics features. In the 1980s, we saw standalone charting programs in addition to the limited charting features within spreadsheets. Now any spreadsheet worth its salt has advanced charting (such as 3-D bar charts), plus great annotation tools. Borland's *Quattro Pro* is so feature-rich that it's positioned as an alternative to standalone presentation graphics packages. We're even seeing drawing and charting modules added to word processors.

The growing integration of features has both its good and bad points. We're getting more powerful, more capable programs; that's good for everyone. We're also getting bigger programs that require more resources. Installing Windows and a graphical word processor, spreadsheet, database, and graphics package can easily fill up a 40MB or 60MB hard disk, even before you start using any of the applications.

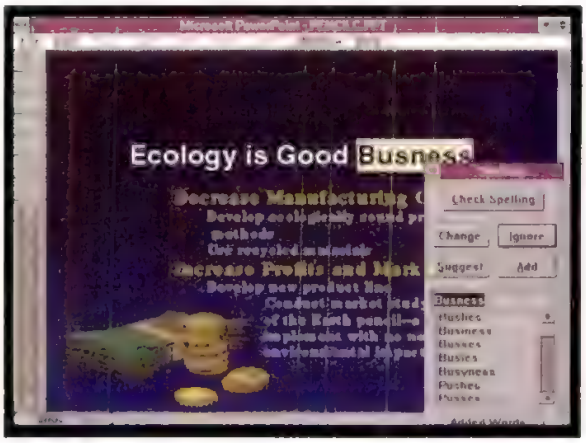
If developers aren't careful, we may end up with more complicated applications that are harder to use. But it doesn't have to be that way. Well-designed applications make their advanced or secondary functions unobtrusive until you need them.

The hardest part may be learning how the different packages implement similar features. When you have products from different vendors, the differences and incompatibilities can be maddening. Even products from the same vendor sometimes implement the same features in very different ways. I'm still waiting for the day when I need only one user dictionary on my hard disk, and it will get used by all the spell-checkers. If I teach my word processor that *LAN* is an acceptable term, why should I have to teach my spreadsheet and my graphics package, too?

Some of these concerns are being addressed by major application vendors who are offering families of applications that all share the same subapplications, such as spell-checkers. But I want to mix and match "best-of-breed" applications (or at least the applications that are best for me), no matter who makes them.

WORKING TOGETHER

Right now, everyone claims file compatibility, and almost everyone is lying or at least stretching the truth. Take a complex document, one with graphics and fonts, and export it from one word processor into another. Save it in the second application's format, and then export it back to the original. You'll immediately see that while the words transfer fine, nearly nothing else does. The same is true in spreadsheets. The numbers and formulas transfer, but the formatting and charts don't.



***Microsoft PowerPoint* has its own spell-checker, a feature borrowed from word processing. But tomorrow's apps will share feature sets, not duplicate them.**

Part of this stems from the vendors who

consider their file formats proprietary and don't want to share them with their competitors. Hogwash. I still don't know why we can't have some basic standards here, perhaps with an independent group like the Software Publishers Association or the Windows Presentation Manager Association acting as a clearinghouse for file formats.

File format compatibility is only the beginning. What we really want is for the *different* parts of applications to work with other applications. Dynamic data exchange (DDE) and object linking and embedding (OLE) are steps in the right direction.

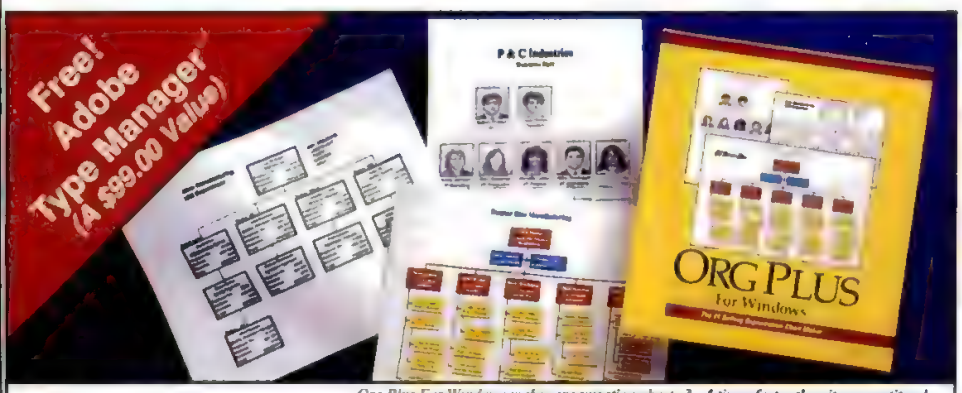
DDE and OLE should let us mix and match those separate modules that most of the major applications are shipping. For instance, I can embed an *Excel* chart in an *Ami Pro* document, then click on it to use *Excel*'s charting module instead of the charting capabilities inside *Ami Pro*. Today, though, this isn't as easy as it could be. Let's hope that OLE will become easier and more powerful.

More to the point, there aren't that many applications that can support OLE yet. I'd like to see vendors make their main applications act as both OLE clients and servers, and subprograms (like the drawing tools integrated within other apps) act as OLE servers. And I want to use OLE servers within our applications without switching to another window. For instance, *Ami Pro* offers in-line editing with its drawing tool. When you click on a drawing within a document, *Ami Pro* gives you another set of tools, so you can always see the drawing in context. We need to standardize this, so you could attach a third-party tool (perhaps with more sophisticated illustration features) and use it the same way. Microsoft's current work on Version 2.0 of the OLE specification should be a step in this direction.

Assume all of this comes to pass, sometime in the not too distant future, say two or three years before it works well enough for most people to try it. This will leave us with multiple applications that share the same tools. You might buy a word processor and a spreadsheet that both come with charting tools, but you might decide to purchase a separate graphics tool that plugs into both. We will have more freedom of choice and more ability to create the applications we really want.

It will also make it more important to choose the right main application for the task. If you're creating a single chart for printing, you might use your spreadsheet. If that chart is going in a document, you might use your word processor. And if you're creating a series of slides for a presentation, you might use a graphics package. In all these cases, you might have been using the same charting tools. What will differ is the interface in the main application.

This also means a major change in the way we view major applications, like word processors and spreadsheets. Today, we view them as huge monoliths that are supposed to do everything. In the future, we may look at them more as integrating environments that bring together different tools for a specific task. And that spells enhanced productivity. ■



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CIRCLE 374 ON READER SERVICE CARD

Bill Machrone

Power Conditioning: You're Doing It Wrong

Delivering clean power to your network is a difficult job, filled with subtleties. So use care; some popular devices may actually hurt your LAN.

The life of a LAN administrator is never dull. You're continually called upon to master new technologies, some of them seemingly far removed from the central business of departmental or enterprise computing. It gets all the more interesting when you have to cross disciplines and get what you need from other departments. You may even have to teach them a thing or two about their own areas of responsibility. Telephony is a good example. Facilities people have learned that they have to care about the computing that goes on at both ends of the wire, and have had to examine new technologies in order to support interconnected servers across the public network.

But down in the bowels of your organization lurks a monster that can bring your LAN to its knees, and it might be entirely beyond your control. That monster is electrical power, of course. We've all heard about power glitches, spikes, sags, and surges. We all know the usual solutions: surge protectors, line conditioners, standby power systems, and uninterruptible power supplies. Each of these devices is designed to solve a particular problem or set of problems. The trick is that you have to know what problem you're trying to solve before you invest in the solutions.

The difficulty doesn't end there, however. Unfortunately, none of the common solutions deal effectively with flaws in your premises' power distribution system. Bad grounds, poorly distributed loads, and noise from electrical equipment all conspire to confound desktop computers. When you interconnect them by some means that includes a ground, such as a shielded cable, you can make the problem much worse.

A BASIC GROUNDING

Ground is a way for electricity to return to "earth" potential, which is vitally important for human safety. Look at this example: With a short circuit, the case of an ungrounded piece of equipment would rise to the line voltage. If you touched it and a grounded object at the same time, you'd get a shock.

Think of ground as a bucket with a hole in the bottom, into which you dump unwanted electricity. The farther you are from an actual earth ground, the smaller the hole in your bucket. The wire running from your wall socket to the main panel has resistance. The longer the wire, the greater the resistance. So if you dump a lot of water into a bucket with a relatively small hole, it'll take some measurable time for the contents to leak down to zero again.

Now imagine that you've got another grounded piece of equipment next to the first. It's plugged into another outlet, and unknown to you, that second outlet has a much shorter run to the main power panel. A fault in the first machine causes power to be dumped to ground. The resistance in the ground path causes the voltage to rise. If you were to touch both pieces of equipment at the same time, you might get a full-blown shock. Now imagine that the two machines are interconnected by a network cable. Suddenly, it's easier for the electrical current to find its way back to ground via the

ILLUSTRATION: JOE SPENCER

second machine's ground than by the first machine's. These errant voltages can appear as noise on your network, causing equipment failures and performance-sapping retries.

THE SHOCKING TRUTH

The electronic components inside your computer are referenced to ground, just as you are. They depend on their ability to detect 5-volt changes from that reference in order to do their job. Unfortunately for electronic equipment,

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people can build up a considerable voltage potential above ground, by simply walking across a carpet or taking off a coat. When you touch your computer, you're not getting a shock, you're giving it a shock. If the thousands of volts flow through the components because of a high-resistance ground, you may be in for a motherboard replacement.

That's why the standard in data processing centers has always been for single-point grounding, in which all equipment is connected to the same big grounding lug. Likewise, the room has a single power supply transformer, usually located as closely as possible to the computers. A LAN that's spread over multiple floors will never be as clean electrically, which is one of the reasons that people install power conditioning equipment, especially surge suppressors.

Unfortunately, a surge suppressor can actually cause problems. There are two kinds of electrical disturbances on power lines: normal mode and common mode. The normal mode is your run-of-the-mill spike, surge, or sag. It happens between the hot and neutral lines. Common-mode problems, however, occur between the neutral and ground lines. If the ground is faulty, they show up as shifts in ground-level voltages. If they're sufficiently large, they can scramble logic circuits or communications.

Most surge suppressors divert normal-mode spikes to ground. If ground has a bit too much resistance, they essentially convert a normal-mode incident to the common mode, where it is potentially more damaging to your system and to data integrity. I'm not saying not to use surge suppressors. But you'd better know why you're using them. If you work in an area with frequent violent lightning storms, you'd be crazy not to use them. But I sincerely doubt that they're going to make your networked computing more reliable.

Fortunately, it's relatively easy to find out how good your power is. An inexpensive line tester will show you which outlets are improperly wired. A digital multimeter will show high-resistance grounds. Add a current clamp to detect ground currents between machines. Your power company can show you how to make these measurements simply and easily. Your network will be glad you did. ■

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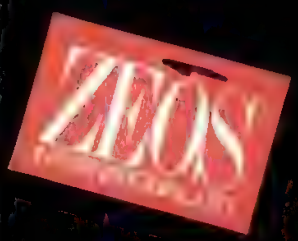

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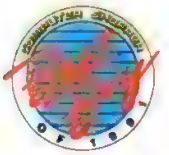

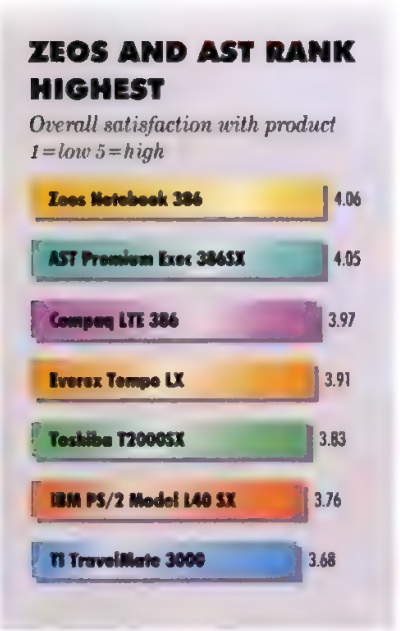

So Do Notebook Users.

Source: PC World survey of customers who own Notebooks, January, 1992.

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John C. Dvorak

New Stealth Viruses: A Menace To Users

Smarter, meaner, harder-to-detect viruses spell trouble for today's personal computers. Be careful you don't catch one.

A scandal erupted when the Michelangelo virus appeared on the hard disk of some new Leading Edge computers. While the virus was tracked down and eradicated, the fact that it happened at all proves that the virus menace is worsening. A number of reports cropped up last year about infected commercial software and even infected preformatted disks. While most of these infections can be trapped and eliminated by virus-scanning software, a new generation of stealth, polymorphic, and multipartite viruses may not be so easy to detect.

Apparently, bored programmers in Russia and Bulgaria are the main source of this new viral technology. There are numerous BBSs in Bulgaria from which coders can download the source code to the newest viruses or upload their modifications. One such underground BBS exists in the Chicago area. It's a new hobby, folks. It's so out of hand there's even a commemorative version of the source code for Dark Avenger, celebrating the program's one-year anniversary. There are even people actively selling viruses through published want ads!

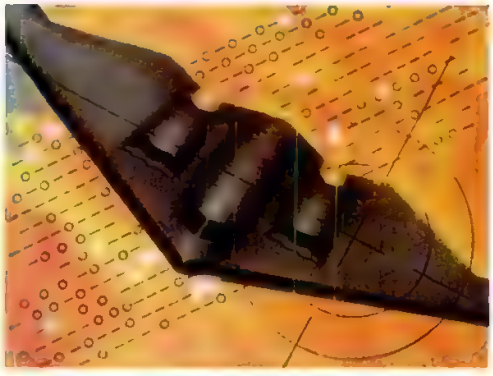
Anyway, the new generation of viruses will be doing the most damage in the years ahead. *Stealth* viruses are designed to hide from detection by fooling scan programs into thinking the original file is intact. This is usually done by infecting DOS's DIR function. Some may go as far as to disinfect themselves when software looks for them, like the 4096 (or Frodo) virus from Israel. It takes more than simple scanning of .EXE and .COM files to find these viruses.

The *polymorphic* virus is another interesting style; it is encrypted and it changes its encryption key itself each time it executes. This means it never looks the same twice, so there's nothing to scan for. The newest comes from Russia, and it's called the Pogue virus. It plays music on the computer from 8 AM to 9 AM and eventually corrupts the hard disk.

More sinister, to my mind, are the so-called *multipartite* viruses epitomized by the Spanish Telecom-2 virus, which was developed to protest higher phone rates in Spain. These kinds of viruses are virtually undetectable. They work by changing the partition table to create a pointer that is addressed before any program is executed. The pointer sends the computer to some "empty clusters" of the hard disk, where the virus code resides. The virus is unleashed, and the program jumps back to the partition table to execute the program originally requested. On a 386 or a 486, this process happens so fast that the user is unaware that anything even happened.

There are estimated to be 1,000 active viruses "in the wild." About 100 are lethal. Most reported viruses are easily detectable, such as the Stoned and the Jerusalem. But new viruses that use more sophisticated antidetection techniques are on the increase.

The key to ending this threat is user awareness and antiviral diligence. To me, this means two products. The newest Certus *Novi* software seems to be the best TSR product to detect and stop viral activity. It's $129 from Certus. Call the company at 216-752-8181. The best detection software is still considered to be *Scan* from John McAfee, which includes code to detect as-yet-undetected viruses. It's inexpensive at $25. Call 408-988-3832 for a copy. Finally, you should be aware of the virus watchdog BBS, Excalibur, maintained by Patricia Hoffman. She also sells a definitive and detailed shareware list of all known viruses. It's called VSUM. A year's subscription costs $30. Call 408-988-3773 or dial in to the Excalibur BBS at 408-244-0813.



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John C.
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Inside Track

It was months ago when it supposedly happened. Novell's Ray Noorda went to meet with Bill Gates. Nobody will say what the meeting was about, but it didn't go well. Apparently, Noorda was **so angered** he went out and bought Digital Research in **retaliation,** or perhaps for defensive purposes. Whatever the case, **a feud was triggered.** DR DOS 6 was released, and then suddenly it was bundled with *NetWare.*

Microsoft is countering by planning to bundle *LAN Manager* with DOS and Windows. Perhaps this plan was what set Noorda off in the first place.

Whatever is happening, the **fallout** could prove damaging to Microsoft if the new rumors are true. The rumor mill says that **Novell-DRI** is working on a **clone of Windows.** The code is from England, where DRI has some hotshot programmers stashed. This project may be the real reason behind the much publicized Microsoft **refusal** to cooperate with Novell-DRI concerning Windows compatibility with DR DOS.

Novell wants to roll out its Windows package before Microsoft comes out with **Windows NT.** Just as with Windows NT, the clone may be completely integrated and not require DR DOS to run. Neither of these products sounds much different from OS/2; in theory, they're both complete operating systems that will run Windows and DOS software.

Suggestion for IBM Dept.: Microsoft took its OS/2 3.0 project and turned it into Windows NT. Obviously, if OS/2 3.0 (a.k.a. Windows NT) can run Windows better than Windows, then so can IBM's OS/2—at least theoretically. My suggestion to IBM: If OS/2 fizzles in the marketplace, **IBM should reintroduce the product as Windows 4.0!** Why not? It's possible that OS/2 is just cursed with a bad moniker. Numerology lives!

The 586 Is Coming Dept.: Intel refers to it as the P5, but we all know that it's the 586 and Intel wants to get it to users by the end of this year. Here are some details.

It will include RISC and CISC aspects and probably be introduced at 50 MHz. It will be **capable of 100 mips,** downwardly compatible, and may implement register renaming with super-pipelined architecture, speculative execution, split instruction, and data caching, among other **whiz-bang** features. According to a lecture that Intel is giving to certain key groups, the P5 will implement what it calls a "5-stage pipeline," and one contact told me that "because of the superscalar architecture, in order to obtain maximum speedup, you will need to recompile your code (even assembly language code) because it needs to be rescheduled for optimum performance on the new architecture."

Gratuitous Plug for a Good Product Dept.: Sometimes I forget to talk about the products I use day in and day out. I was reminded of this as I read an ad for the new **NEC MultiSync 4FG** monitor, which I've been using continuously for months. Besides being beautifully designed and having superb clarity, it has incorporated new technologies that **reduce ELF and VLF emissions** to meet the most rigid standards.

More interesting to me, though, is some sort of **antistatic** coating on the screen itself. It wasn't until I read about the 4FG last week that I realized that **I have not cleaned the screen** for over four months and it's still sparkling. This is peculiar since during this period I've had some major dust problems in my office due to a construction mess (a new wall and bathroom). Dust is on everything—except this one monitor. **It's weird.** It's amazing. I can't recommend this monitor enough. It seems to be the current favorite among most insiders.

CD-ROM of the Month Dept.: The Bureau of Economic Analysis did some analysis on itself and decided that it would better serve the country by moving the voluminous data it collects onto CD-ROMs and then selling the CD-ROM at a **low price.** You can buy the REIS (Regional Economic Information System) on-disk for $35!! This disk contains economic data for 3,107 counties and 337 metropolitan areas for the years 1969 through 1989 and includes personal income data, farm income, SIC breakdowns, employment stats, and more. **Over 450 megabytes of organized statistics.** This is what CD-ROM is all about. One vendor told the Department, "Now any high school student can afford to have the best data available. George Bush can't get any better information!" **Kudos** to the Bureau and the Department of Commerce. Request Accession no. 55-89-30-599. Call 202-254-6630 to order a copy or fax them at 202-254-7713.

Genuinely Interesting Software Dept.: While many of you have discovered **various bugs** in the clocks of the PC clone, one problem seems to be common across all clocks. They lose a small amount of time every day—about 20 seconds. Worse, there are apparently applications that **throw the DOS clock out of sync** with the system clock. Pacific Standard Time (408-246-0589) has a $19.95 utility called CLOCK that adjusts the clock appropriately and without hassle. Worth a look. ■

Look out, Microsoft! The rumor mill says that Novell-Digital Research is cloning Windows in England, where DRI has stashed some hotshot programmers.

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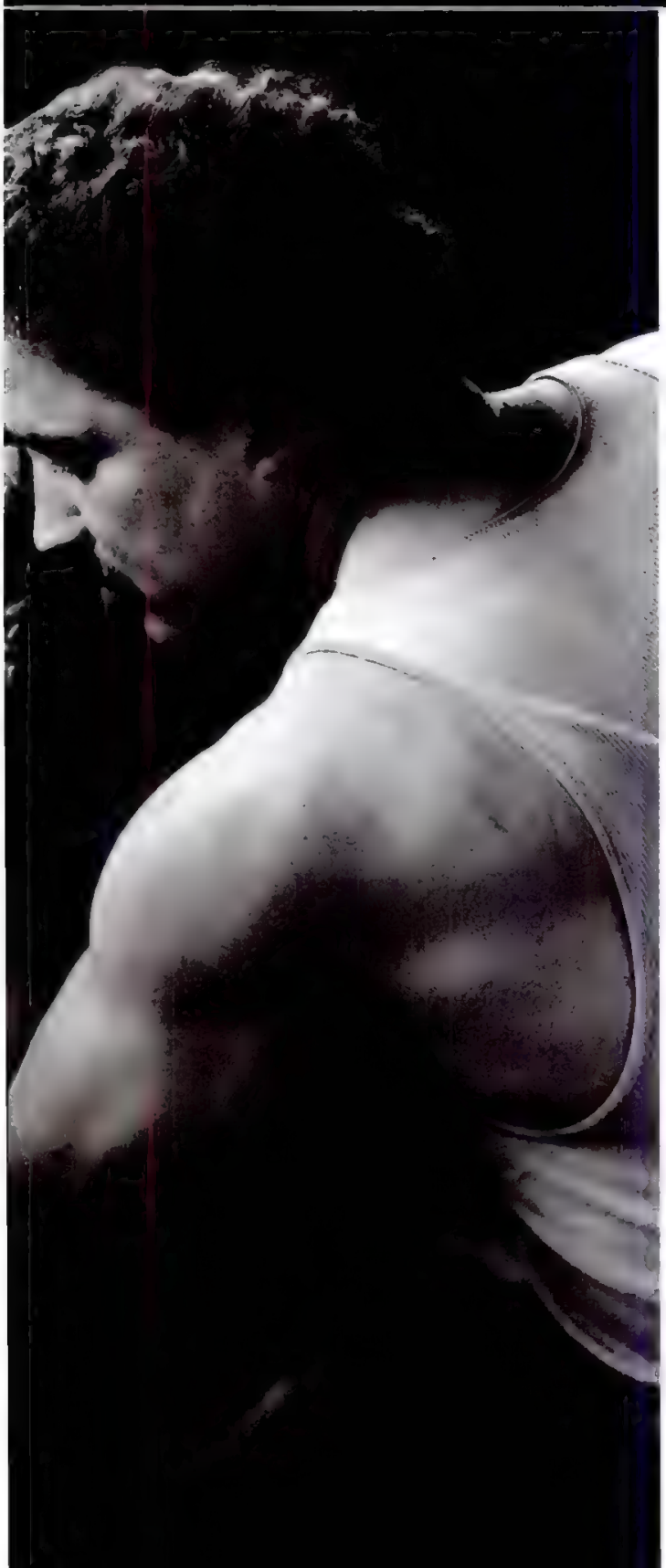

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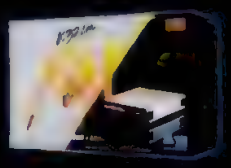

Jim Seymour

Toward Better PC "Illusions"

Perception shapes reality. Tomorrow's more powerful CPUs and smarter design tools will allow PCs to better simulate what is real, making our lives easier.

One of the most basic parts of the conventional wisdom about PCs goes something like this: Until now, PCs haven't really had enough computing power to devote much attention to superior user interfaces and other fundamental ease-of-use issues. Most of the available power has been sopped up by what users think of as actual computing work—adding up a column of figures in a spreadsheet, for example. But now, conventional wisdom holds that we're finally getting to the point where we can steal some CPU cycles from the nitty-gritty stuff and divert them to making computers (and the applications we run on them) easier to use.

That notion is deeply embedded in the minds of PC designers, PC resellers, and PC users. Indeed, I have subscribed to it myself.

I confess that I worry that we've been holding this out as a Profound Truth ever since 1984, when with the advent of the 80286 chip and IBM PC ATs, we were supposed to have turned the corner on the power versus ease-of-use dilemma. Yet we still talk as if the PCs we use are just now creeping up to a performance level powerful enough to start making things really easy to use. Will we be saying the same thing when we're greeting the appearance of the 80986, with its 8 billion transistors and direct access to 64 terabytes of essentially instantaneous RAM?

At any rate, one price we pay for holding stoutly to fundamental truths is to be shaken when someone who ought to know better challenges these truths in public. Technology heretics are particularly suspect: This interface versus actual computing stuff ought to be easily quantifiable—it's all binary, isn't it?—and so there shouldn't be much to debate.

I was brought up short a few months ago when I read first in a business-magazine story, and then again later in a computer-industry newsletter, an arresting quote from Bud Tribble, vice president of software engineering at NeXT Inc. Tribble said, "On the desktop today, 80 percent of computing power is going toward ease of use, such as menus, windows, and pop-ups. Only 20 percent is actually going towards doing the job, such as calculating your spreadsheet."

Tribble ought to know better. A distinguished career has been capped by his role as the force behind NextStep, NeXT's brilliant development environment cum operating system. So why does he go around saying things like that?

I caught up with Bud on a sabbatical from his work at NeXT. What he told me was even more interesting than that provocative quote.

Tribble wasn't carping about the amount of power devoted to interfaces; far from it. "The one thing worth devoting computer power to *is* the interface," he says. "But there's a paradox: The simpler the interface, the more CPU cycles you use up.

"A significant amount of power goes into creating intuitive representations for computer users," Tribble says. "And truly intuitive representations are what good interfaces are all about. It's a carefully thought-out illusion that a user is directly editing a page of text in a document, or manipulating a cell in a spreadsheet, or rotating a wireframe view of a jet engine in a CAD package. Interfaces are all about fostering these 'appropriate illusions,' and the more realistic the illusion, the more demanding it is in terms of power."

ILLUSTRATION: JOE SPENCER

Moving around a few numbers in a spreadsheet or a couple of hundred characters in a short word processing document takes very little power. "But when you get into the things users like in today's environments, things like drag and drop, they take a *lot* of CPU cycles. And something like rotating a 3-D graph in space in real time," Tribble says, "might take

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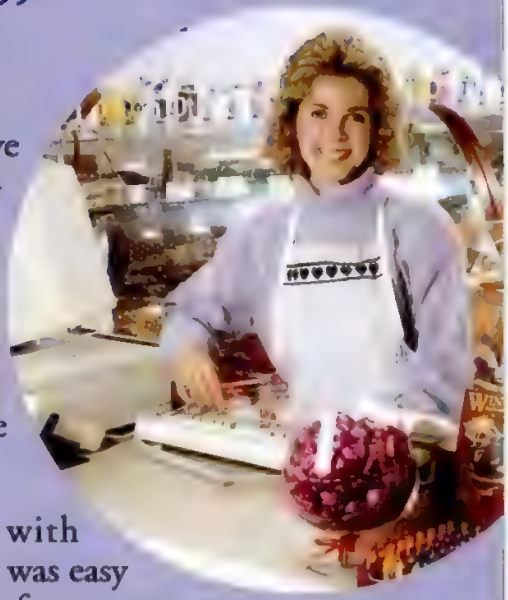

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20 or 30 mips (million instructions per second). That's real computing power, and it's all going into the interface, into a representation of the calculations, not the calculations themselves."

Tribble's work so far has focused on conserving CPU cycles, and programmers' development time, by making it possible to create representations and manipulative tools more easily. "In the bad old days," he says, "doing something like opening a box on-screen, putting in some text, and adding some buttons took a lot of programmer time. With NextStep, we put the toolbox to do those things inside the system, so it takes a NextStep programmer just a few seconds to get that done."

NextStep succeeds brilliantly at that kind of programmer productivity. Now that NeXT has ported NextStep over to Intel 80x86 chips—becoming, in effect, as much a software house as a hardware vendor—we'll see the rewards of that smart toolbox applied in a much larger arena.

Far from bemoaning the diversion of CPU cycles into interface issues—or representations—Tribble welcomes these better, more easily understood "illusions." And he wasn't carping about the use of computer power so much as expanding our understanding of a fundamental truth.

POWER FOR ILLUSIONS

Until now we have had to devote much of the power available on a given platform (defined as hardware plus operating system) to presenting appropriate representations of the work the user was addressing. But that suggests neither that we should start reassigning CPU cycles, nor that we've turned some magic corner in reducing the power needed for our illusions.

Far from outgrowing those illusions and the need for them, we are entering a time when the quality of those illusions—the increased sense of direct manipulation of on-screen elements in something approaching real time—will become the litmus test for judging the "performance" of a given platform.

We had it right, but so did Bud Tribble. He redefined our fundamental truth by restating it. ■

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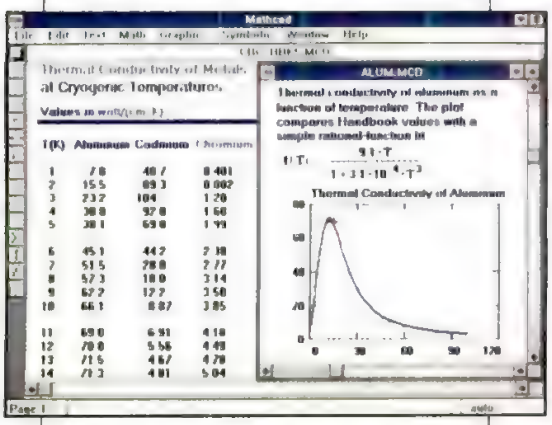

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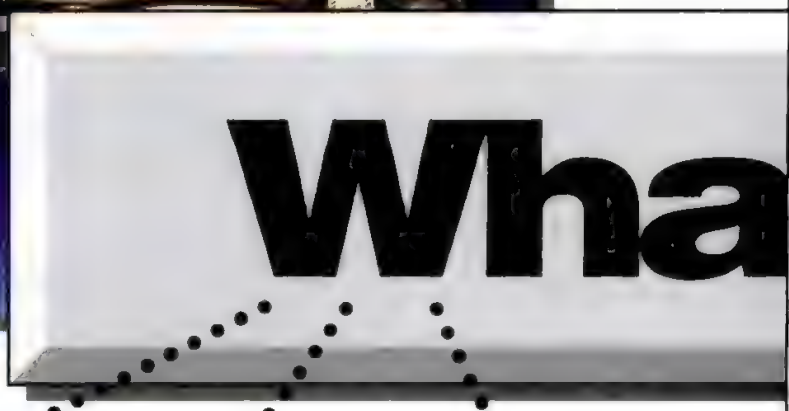

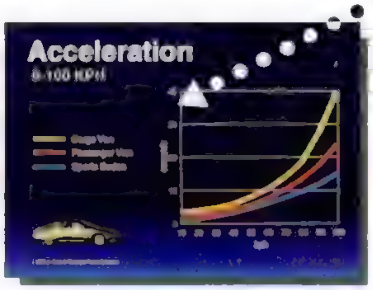

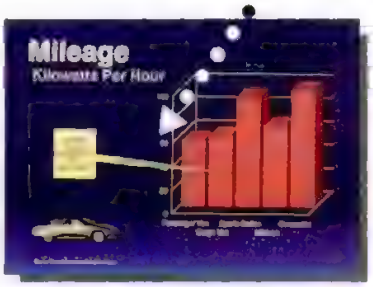

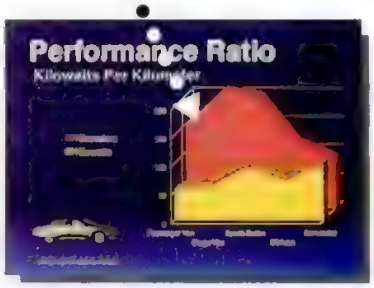

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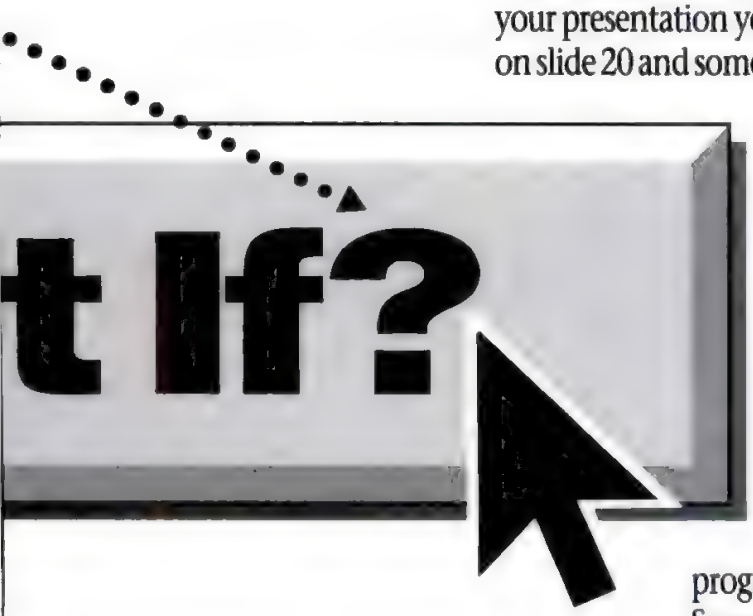

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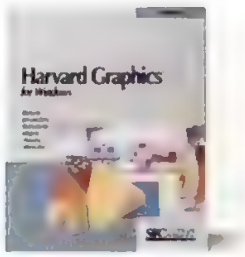

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CIRCLE 245 ON READER SERVICE CARD

William F. Zachmann

Prediction Number 13: C++ Goes Mainstream

C++ is moving full speed ahead, but how do we develop the skills we need to move along with it?

Call me superstitious, but I've *always* made 13 year-end predictions, ever since I started doing this in 1982. This year, due to editorial space constraints, one of my 1992 predictions was eliminated from my January 14, 1992, column. Here's the missing prediction:

PREDICTION 13: C++'s STAR RISING FAST FOR CORPORATE AMERICA

With last year's bevy of new compilers, class libraries, and other development tools, C++ has already established itself as the fastest growing language (probably the only growing language) in programming circles. Its combination of conventional programming with object-oriented capabilities will make it the hottest programming language for serious development in the coming year.

But while it's a given that C++ is on its way to the top in the elite programming echelons, there's another important question we need to ask. How can C++ gain widespread acceptance in more mainstream user organizations?

It's understandable that software developers who build commercial "shrink-wrap products" will take advantage of the power of C++. But what about the rest of us?

Today, in the typical company, hardly anybody knows anything about the C language, let alone C++. End users, even very sophisticated ones, are unlikely to use programming languages that are any more complicated than BASIC. More typically, even a power user does not go beyond the macro language of products like *Lotus 1-2-3* or *Microsoft Excel*.

IS (information systems) professionals, on the other hand, are most likely to be at home with COBOL or perhaps PL/1. In most organizations, only a very small number of these IS professionals know anything about C or C++.

But if my thirteenth prediction is to come true, we'll need to find a bunch of capable new C++ programmers. Where can we find them?

Is it practical to spend the enormous sums that the formal training of lots of programmers requires? Probably not. There is, however, another approach. The key lies in recognizing a motivated C++ programmer-to-be. The goal is to provide anyone in the organization who is interested in learning C++ with strong encouragement and basic assistance. One very good way to do that is simply to provide a copy of Borland's Turbo C++ for Windows (Borland's $149 Windows entry-level language) and *The World of C++*, an enlightening video about object-oriented programming (available from Borland International for $99.95) to anyone who wants to learn the language.

Not only is this an inexpensive solution, but it has the virtue of creating a self-selection process. Individuals who are motivated to learn C++ will be just the sort of "self-starters" who are likely to become the best programmers anyway.

As the most motivated and most capable start to learn their way around C++, they should be encouraged to aid and assist those who perhaps are not quite as highly motivated or able. This way, an organization can "bootstrap" itself into new IS skills at very low cost.

ILLUSTRATION: JOE SPENCER

This strategy applies to C++, but you can use the same idea to develop other IS skills in the organization. Languages like Pascal and BASIC, skills such as LAN and DBMS (database management system) knowledge, and other needed IS capabilities can be developed internally by any organization willing to make a modest investment in basic learning tools for the self-motivated. This will supplement more expensive formal training approaches and encourage a more positive environment for using information technology. ■

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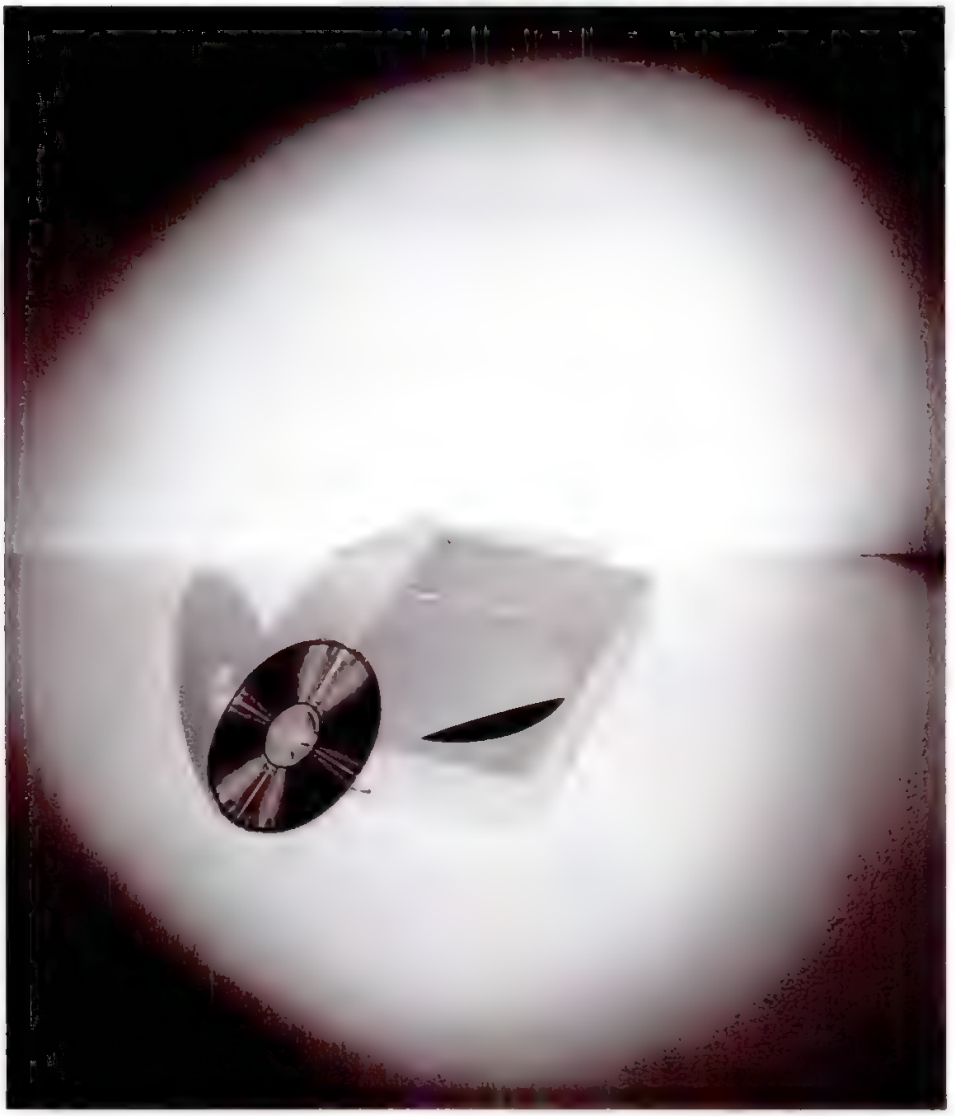

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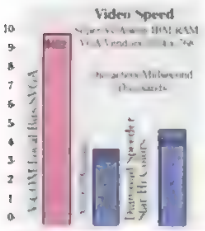

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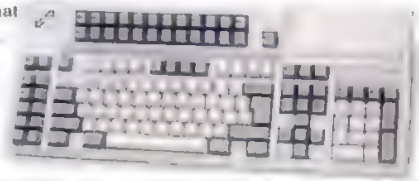

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HIGH-END NOTEBOOK PCs

by Bill Howard

IN THIS REVIEW:

- AST Premium Exec 386SX/25
- AT&T Safari NSX/20 Notebook Computer
- Compaq LTE Lite/25
- Everex Tempo Carrier 386SX/20
- GRiD 1755
- Librex 386SX Notebook
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- Toshiba T4400SX
- ZDS MastersPort 386SLe

The reason you should buy a notebook computer, according to current conventional wisdom, is because it offers virtually all the performance of a desktop PC. We have said this in the past, ourselves. But the reality is that a 486/33 desktop system's CPU runs *a lot* faster than a leading-edge portable—as much as three times as fast on PC Magazine Labs' processor benchmark test. It's hard not to notice that kind of difference, even when you run everyday applications.

Still, for many users, a 20- or 25-MHz SX-based notebook with a fast video chip and a respectable hard disk (at least 60MB, preferably 80MB) is enough. If you do want to replace your desktop PC and your

PHOTOGRAPHY: THOM O'CONNOR

underpowered 10-pound laptop PC with a single do-it-all portable, you may find the answer in one of these 14 386SX, 386SL, and 486SX notebook computers from AST, AT&T, Compaq, Everex, GRiD, Librex, NEC (two systems), Philips, Texas Instruments, Toshiba (two systems), and Zenith Data Systems (ZDS).

Nine of these 5- to 7.5-pound systems are based on Intel's 20-MHz 386SX chip. Five vendors use CPUs that are more power conscious, faster, or both: NEC (the 386SL/20), Compaq and ZDS (the 386SL/25), AST (AMD's Am386SXL/20), and Toshiba (the 486SX/25). These five vendors provide most of the fireworks in this set of reviews: the most performance, the best battery life, the best combination of low travel weight and long battery life. They are the first wave of the advanced machines you will see through the rest of 1992.

With this issue, we introduce an enhanced edition of PC Magazine Labs' Hardware Performance Tests, Release 6.0. There are additional tests to measure graphics and text performance under Microsoft Windows 3.0, and we have tweaked the presentation of our Battery Rundown test. For details, see "How We Tested" in the benchmark test section.

SL: AN EMERGING STANDARD

One thing clear about portable-computer design is that Intel's 25- and 20-MHz SL chip sets and AMD's competing 25-MHz design are the way to go if you want to maximize battery life. The SL chip set also integrates more functionality in less real estate, allowing for slightly smaller and lighter systems. You should expect to see only Intel SL or AMD SXL notebook designs introduced by the major players; making a non-SL design power-efficient is too much work. Even Toshiba, which has done well by its T2000/T2200 SX series, will climb on-board the SL bandwagon, starting with its 25-MHz T3300SL. You may still see SX systems emerge from less-well-known companies, which will probably say, "With careful design, we can provide virtually all the features and battery life of an SL system." Translation: "We're working on SL systems, too. Just give us time."

The i386SL Microprocessor SuperSet, as Intel calls this processor, is really a two-chip set. The first and most highly integrated chip has a 386-compatible CPU at its core, with all of the control logic for main memory, optional cache memory, and peripheral I/O expansion interfaces. The second chip, called the 82360SL, contains a complete set of I/O interfaces, including IDE hard disk and floppy disk support, a parallel port, serial ports, a real-time clock, and interrupt and DMA controllers.

Both chips feature low-power, fully static technology, with specially designed power-management features. When you're working on less-power-intensive tasks, such as entering text in a document, the chip's system management interrupt (SMI) allows the CPU to slow and turns off as many as six I/O devices. When an SMI occurs, the system's state is saved in system management RAM; application programs, the operating system, the BIOS, or even a processor mode can execute the power-conservation functions. CPU speed can be reduced to any of three slower rates or, in the SL's sleepiest mode, a dead stop.

We have seen portables show a steady improvement in battery life over the past year.

IMPROVING BATTERY LIFE

How much battery life should you expect? Intel says the important thing is not just how many hours you can tap at the

OUR CONTRIBUTORS

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HIGHLIGHTS: Notebook Portables

- A leading-edge notebook portable today weighs 5.5 to 7 pounds with battery, measures about 8.5 by 11 by 2 inches, and uses a 20- or 25-MHz 386SX CPU.

- Of the 14 systems we tested, 5 used advanced chip designs: the NEC UltraLite SL/20 (Intel 386SL/20), the Compaq LTE Lite/25 and ZDS MastersPort 386SLe (Intel 386SL/25), the AST Premium Exec 386SX/25 (Am386SXL/25), and the Toshiba 4400SX (Intel 486SX/25). The other 9 used Intel 386SX/20 CPUs.

- The battery life is dependent both on system efficiency and battery size. Battery lives ranged from 1 hour 20 minutes (Librex 386SX Notebook) to 4 hours 19 minutes (Toshiba T4400SX). All but two notebooks used nickel cadmium. The Toshiba T2200SX and Compaq LTE/Lite 25 used nickel hydride.

- The Toshiba T2200SX was the only system with a battery life of more than 3 hours that also has a travel weight (with AC adapter) of less than 7 pounds.

- The performance ratio, from fastest to slowest, on the disk and video benchmark tests was about 3:1. The 486SX-based Toshiba T4400SX was the fastest in terms of CPU performance. This notebook was the second-fastest on the video test, passed only by the Compaq LTE Lite/25.

- Hard disk size is more important than performance. Your best choice is a hard disk size somewhere in the 60MB-to-80MB range; 120MB hard disks will be more available by midyear. Leave 40MB hard disks to less powerful systems, and avoid 20MB units unless you are buying a 286 portable at an attractive closeout price (about $1,000). ■

keyboard, but whether you can leave your system running throughout the average business day and not exhaust the battery. In a typical day, you might write a memo for 15 minutes, set your computer aside for half an hour, work on a spreadsheet for another half-hour, then take notes during a 50-minute meeting. The SL and SXL chips best handle this stop-and-go computing. As a broad rule, Intel says an SL-based machine might produce a 50 percent longer life in real-world situations. Frankly, we are not positive if present-day battery-rundown tests—ours included—can measure this kind of intermittent use because every person has a different use profile.

Still, we have seen a steady improvement in battery life over the past year, even on our Battery Rundown test, which represents more of a worst-case, continuous-use environment. In a review of 27 386SX notebooks last summer ("Desktop Power, Notebook Size," *PC Magazine*, August 1991), the median battery life was 2 hours 5 minutes. (Half the machines were better, half were worse.) More recently, among 15 low-cost SX systems ("The $2,000 Notebook PC," January 28, 1992), the median was 2:03. In this issue, with a more powerful group of systems, the median battery life was 2:28, and the results ranged from 1:20 for the Librex 386SX Notebook to more than 4 hours for three systems: the Toshiba T4400SX (4:19), AST Premium Exec 386SX/25 (4:06), and AT&T Safari NSX/20 Notebook Computer (also 4:06). In this review, only three systems lasted for less than 2 hours: the Everex Tempo Carrier 386SX/20 (1:46), the NEC UltraLite III (1:45), and the Librex 386SX Notebook (1:20).

It's no secret that one easy way to get a long battery life is to install a big battery. Among the 14 systems in this review, the median battery weighed 1.2 pounds and provided roughly 2 hours 20 minutes of power per pound of battery weight. Hours per pound is a measure of efficiency something like miles per gallon, while total battery life is akin to the total driving distance on a tank of gas. (A 15-mile-per-gallon Cadillac with a 20-gallon tank and a 20-mile-per-gallon BMW with a 15-gallon tank both have a 300-mile driving range.) The Toshiba T4400SX's battery lasted the longest, but it was next to last on efficiency, at 1:51 per pound. (In fairness, we should mention that the Toshiba T4400SX came with a 486SX/25 proces-

PRICE/PERFORMANCE INDEX

The performance/features champs are the Compaq LTE Lite/25 (386SL/25) and the Toshiba T4400SX (486SX/25), with their 100- and 118-point scores, respectively. The NEC UltraLite III (386SX/20) requires the smallest cash outlay, but you will get fewer features and less performance than with comparable but more costly systems.

Top-notch benchmark test scores for the LTE Lite/25 and the Toshiba T4400SX increased their heavy lead over the remaining systems. The Toshiba 486SX/25's memory throughput was nearly double that of the next fastest system, and the LTE Lite/25's superfast video ran rings around the competition in the DOS- and Windows-based testing.

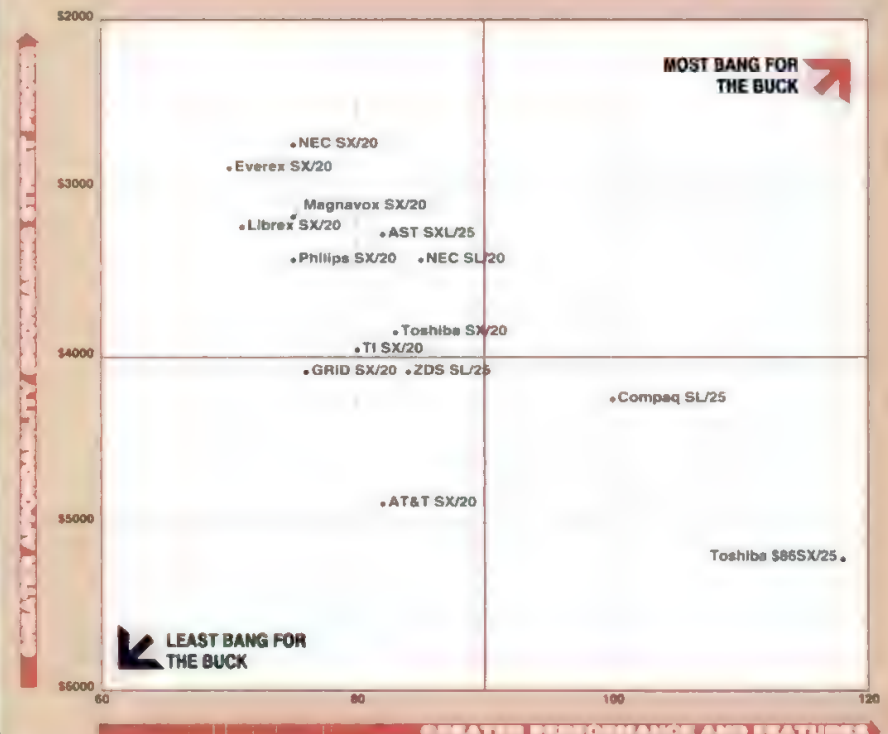
The chart below rates the 14 notebook computers on more than 20 features and performance items and plots them against each computer's selling price. The *x*-axis measures increasing performance. The *y*-axis measures increasing affordability (lower price).

THE DATA POINTS

The following elements make up the performance/features score: benchmark test scores (40 percent); travel weight, size, and battery life (25 percent); memory and disk space (15 percent); screen size, modem, Super VGA output, extra cursor keys, I/O ports, power-conservation features, free software, an extended warranty, and on-site service availability (20 percent).

The selling price, charted on the *y*-axis, includes the system price and the price of the most useful modem. We discounted laptops available through dealers by 15 percent to approximate street prices. We did not discount mail-order systems.

To view the data we used to create this chart, look for 07BANG.WK1 in the Sotware Library of PC MagNet's Editorial Forum.



sor.) The most efficient systems yielded more than 3 hours per battery pound. It's no coincidence that the efficiency champs—the AST Premium Exec 386SX/25 and the NEC UltraLite SL/20—used the advanced-chip designs. But the SL chip does not automatically create a more efficient laptop. The 25-MHz SL-based ZDS MastersPort 386SLe was the seventh most efficient system in the roundup.

TRAVEL WEIGHT VS. BATTERY LIFE

We suspect most users look for the best combination of acceptable weight and long battery life, so we've expanded the information provided by our Battery Rundown test. We will continue to report overall battery life and battery life per pound. The trade-offs chart plotting battery life against travel weight (computer, battery, and power transformer) is new. Run your finger across the chart and decide how much

LAPTOP FEATURES: What You Really Want

by Bill Howard

The best notebook system may not be the one with the most mips. It is the features set that matters. Here are some features that distinguish the better notebook systems:

- **Big-screen, higher-resolution external output.** The best displays approach 10 inches diagonally and are close to the standard 4:3 display ratio of desktop monitors. Some systems provide an 800-by-600 or a 1,024-by-768 resolution when you connect them to an external display. The Compaq LTE Lite/25 allows dual display: an internal LCD screen and a simultaneously illuminated external monitor (at 640-by-480 resolution).

- **A built-in mouse port.** An increasing number of systems use the IBM PS/2 connector (rather than the serial port) for quick attachment of a trackball or mouse. If only Microsoft and Logitech would get on the ball and ship their clip-on trackballs with PS/2 connectors, rather than 9-pin serial connectors with serial-to-PS/2 adapter cords. If you are a frequent trackball user, look for a notebook with the floppy disk drive in front rather than on the right, where the trackball gets in the way. None of the reviewed machines have built-in pointing devices. Pointing devices on notebooks that do have them are not as good as external devices, but they are always available and don't add much bulk or cost.

- **A small transformer.** A transformer doesn't need to be much bigger than 3 by 6 inches. Toshiba showed us it could be done. Since the best AC power adapters are so small, we highly recommend buying two. Keep one at the office and one at home. If you want to use your laptop in your car, some brands offer separate 12-volt adapters. You are far better off with $100-and-up transformers that provide surge protection than with simple, sub-$50 adapters that step down the voltage.

- **A quick-change, quick-charge battery.** Just about everyone has this now. Many systems let you change batteries without powering down. Better systems let your battery recharge in 1 to 2 hours, but some still require recharging with the power off.

- **Full-size keys, inverted-T cursor-key layout.** Take a ruler and measure across any ten keys. If this distance is less than 7.5 inches, the maker squeezed the keyboard. We're less concerned about the size and shape of the function keys, but we do believe the only acceptable layout for the cursor keys is in an inverted T. We are glad to see that Compaq finally abandoned its silly inverted-L layout (we've been saying for two years that this layout is impossible to use on an 8.5- by 11-inch notebook system). Best of all is an inverted-T layout plus separate keys for PgUp, PgDn, Home, and End. A few systems in this review needed two function-key combinations to move quickly around the keyboard.

- **A fast parallel port.** All systems based on the 25-MHz 386SL chip set include control logic for the Xircom/Intel-developed Enhanced Parallel Port. This port theoretically provides ten times the throughput of a traditional parallel port. That means your external network adapter can run virtually as fast as a desktop PC's internal adapter, rather than half as fast. Once desktop PCs get this technology as well, you can transfer files by using programs such as *LapLink* at 1 megabit per second rather than 50 to 100 kilobits per second.

- **Accessible, well-labeled connectors.** Sooner or later, the modesty panels covering the I/O connectors will fall off; it's a given. We dislike a single full-width modesty panel that must be opened even if you need to access just one I/O connector. The I/O connectors you use all the time (power, modem, and mouse) should be left open or on a smaller, hinged flap. We also prefer the connectors be labeled in English, at least for the North American models. It's easier to recognize the word "serial" than to realize that "1010101" signifies the binary stream of data that leaves the serial port, and therefore—aha—this must be the serial port.

- **Docking stations.** Most docking stations cost $1,000, twice what they should. The increasing level of built-in capability makes them less desirable than ever, but we recognize that many users like them. The best ones should make all the connections for you rather than force you to connect separate plugs and cables. One leading maker plans to produce a unit with slightly reduced functionality, for well under $500. Let's hope it catches on.

- **Color.** None of these systems have color displays; but while there were only a few super-expensive, AC-only oddities two years ago, more than a dozen serious sub-$5,000 battery-powered systems should be available by this year's end. Just remember that the color technology you want, active matrix, still adds $2,000-plus to the cost, while the somewhat more washed-out passive-matrix displays add about $1,000 to the price. ■

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IN A CATEGORY OBSE AND LIGHTER, COMPAQ W ANOTHER ADJE

Make it smaller. Make it lighter. Make it lighter. Make it smaller.

These must be the mandates emblazoned upon every R&D document handed to the engineers of today's crop of notebook computers.

Admirable goals to be sure. Goals that the engineers at Compaq, however, believe fall well short of making the most of portable computing.

Accurate to within minutes, the COMPAQ Power Smart Pack battery gauge clearly displays remaining battery life at the touch of a button.

Which explains why the latest 386SL notebook technology from the labs in Houston — the new COMPAQ LTE Lite/25 and LTE Lite/20 PCs — are not only the lightest (a scant 6 lbs.) and the smallest (only 8.5"x11"x1.75") notebook PCs that we've ever built. They're also the smartest.

The COMPAQ Hibernation feature saves all open files to the hard drive and turns the unit off, either upon request or as an automatic feature. Power up the COMPAQ LTE Lite later and you're back exactly where you left off.

THE BRAINS BEHIND THE OPERATION.

When it came time to design a new notebook, we started (logically enough) with the battery.

The new COMPAQ Power Smart Pack battery in our new notebooks delivers up to 4.5 hours of computing, a full hour longer than most.

A microprocessor inside the battery itself monitors current usage levels and continually calculates the available power remaining.

It can even instruct the notebook to save all open files to the hard drive should the battery power run too low.

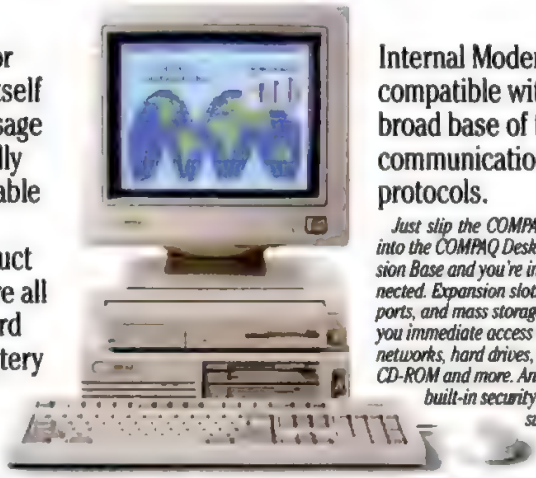
And the energy-saving features in our newest notebooks go far beyond the presence of an Intel 386SL chip.

To make the most of the smarter battery, the new COMPAQ LTE Lite also comes with user-adjustable power-drain settings, and three different sleep modes — System Idle, System Standby, and Hibernation.

A MOST MODERN MODEM.

Our optional 9600-bps modem for the COMPAQ LTE Lite PCs would make even Alexander Graham B. proud.

The COMPAQ Enhanced 9600-bps Internal Modem is compatible with the broad base of today's communications protocols.



Just slip the COMPAQ LTE Lite into the COMPAQ Desktop Expansion Base and you're instantly connected. Expansion slots, external ports, and mass storage bays give you immediate access to monitors, networks, hard drives, tape drives, CD-ROM and more. And all the while, built-in security features ensure a safe harbor for your notebook.

In modem talk, that means true V.32 9600-bps data transmission and V.42bis compression for up to 38.4 kbps throughput, as well as full support for Hayes AutoSync.

This little marvel negotiates the fastest transmission throughput that the other end of the line can muster, whether it's sending or receiving.

It even drops to a low power-drain standby state and monitors incoming signals if you're waiting for a call to come in.

Or for that matter, another modem to catch up.

NOT ONLY SMART, BUT BRIGHT.

The new, efficient COMPAQ Maxlight VGA display makes for a much brighter screen than our previous notebooks, and does it without sacrificing battery life.

Sharper graphics and text in up

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SSED WITH SMALLER OULD LIKE TO SUGGEST CTIVE: SMARTER.

to 64 shades of gray complement an enhanced video subsystem that's so fast it virtually eliminates "submarining," better known as "where did that #%$**# cursor go?"

A NOTEBOOK THAT'S USELESS IN THE WRONG HANDS.

At Compaq, we realize that data security is every bit as important as hardware security.

At the hardware level, DriveLock locks the hard drive, preventing access to data even if the drive is removed.

One-touch QuickLock and QuickBlank functions

Isolated inverted "T" cursor controls are in a familiar position so you don't have to teach your fingers new tricks.

allow you to quickly (surprise) disable the keyboard or blank the screen.

And of course, our new notebooks come with a Keylock slot for an optional cable lock.

With all of the above, plus a 120-MB hard drive,* RAM expansion to 10 MB, cache memory, simultaneous display, and an auxiliary battery, to say these are the best notebooks we've ever made would be something of an understatement.

To back them with a one-year worldwide warranty and our toll-free Compaq Customer Support Center hotline would be more like it.

intel inside

So don't choose between a small notebook and a smart notebook. Choose both.

Choose the new COMPAQ LTE Lite. For information about our new notebooks or an Authorized COMPAQ Reseller near you, call Compaq in the U.S. at 1-800-231-0900, Ext. 100, or in Canada at 1-800-263-5868, Ext. 100.

COMPAQ

Actual weight: 6 lbs. Actual dimensions: 8.5" x 11" x 1.75". Actually, this is the best notebook we've ever built.

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weight you're willing to put up with, then see who gives you the most battery life at that travel weight. The winner here is the Toshiba T2200SX, the only system with a travel weight under 7 pounds and battery life over 3 hours. (While its battery life was excellent, its efficiency was not. Equipped with nickel hydride cells—supposedly 20 percent more efficient, pound for pound, than nickel cadmium batteries—the Toshiba T2200SX ranked some 5 percent below average.)

If you can live with less battery life (just short of 2:30) and about 7.5 pounds of travel weight, look to the GRiD 1755, the Philips LX320, the TI TravelMate 3000 WinSX, and the NEC UltraLite SL/20. If you want a 4-hour battery life and are willing to live with about 8 pounds of travel weight, consider the AST Premium Exec 386SX/25 or AT&T's Safari NSX/20 Notebook Computer. Or buy a heavy-duty carrying case, get the Toshiba T4400SX, and be careful not to drop it on the Energizer rabbit. A direct hit and he would be the Energizer pancake.

TESTING: WHO FARED BEST

Given the wide range of CPUs among our 14 systems, from a 486SX/25 (with the 486 family's internal 8K processor RAM cache) to an uncached 386SX/20, it is not surprising that we found almost a 3-to-1 difference between the fastest (Toshiba T4400SX) and the slowest (Toshiba T2200SX, Everex Tempo Carrier 386SX/20, and NEC UltraLite III) on our processor test. (Among the 386SX- and 386SL-based systems, the Compaq LTE Lite/25 was the fastest and turned in a processor throughput about 1.5 times as high as the slowest three.) There is also about a 6-to-1 difference between the fastest and slowest notebook on the video test. The LTE Lite/25 blew away the competition here and on the Windows graphics test, and the two Toshibas came in second and third.

Hard disk performance is similar across all 14 systems, and we measured this without any software disk cache loaded. You should use a disk cache, and when you do, you will find the performance curve to be an almost horizontal line. The real issue today is not speed but the capacity of the 2.5-inch hard disks used by

PC MAGAZINE EDITORS' CHOICE

- **Compaq LTE Lite/25 (386SL/25)**
- **Toshiba T2200SX (386SX/20)**
- **Toshiba T4400SX (486SX/25)**

If you need mips, your best choice is the 25-MHz 486SX-based Toshiba T4400SX, the only 486-based notebook computer among the 14 we reviewed. It is the fastest notebook by a healthy margin and has the longest battery life. Its travel weight, a bit less than 9 pounds with its battery and AC adapter, would have been sensational a year ago. Here, it represents a 2- to 3-pound disadvantage, and at more than $6,000 with 4MB of RAM, an 80MB hard disk, and DOS, it is one of the more expensive systems.

When your budget calls for something less than the Toshiba T4400SX's size and $6,000-plus price, however, you still have two excellent choices—the Compaq LTE Lite/25 and the Toshiba T2200SX. The 25-MHz SL-based Compaq PC has superior CPU and video performance, a host of security features, simultaneous internal and external display, Super VGA video output, and (finally!) an inverted-T cursor-key layout.

A $4,298 price for a system with an 84MB hard disk ($3,794 for the 60MB model) makes Compaq much more price-competitive. The company also offers a 20-MHz version, the Compaq LTE Lite/20, but what you give up in performance and base-level features outweighs the $500 to $600 price difference, in our opinion.

The 386SX/20-based Toshiba T2200SX ($4,778 with a 60MB hard disk) is one of the most convenient, well-rounded systems of the lot. It has first-class video performance, weighs just 6.5 pounds with its AC power adapter, and runs more than 3 hours on batteries. Lighter systems had shorter battery lives, while longer-lasting notebooks were heavier.

Neither the LTE Lite/25 nor the Toshiba T2200SX is perfect: Compaq's stiffly sprung keyboard requires more force than some users may find acceptable. Two features that add to the LTE Lite/25's appeal will not be available until spring: a 120MB hard disk and a 9,600-bps modem. Toshiba's modem-on-a-card product is in short supply, only runs at 2,400 bps, and requires a clumsy adapter cable for connection to the phone line. And its uncached 20-MHz CPU makes this PC a step or two slower than the Compaq PC.

OTHERS TO CONSIDER

Several notebooks came with outstanding features and may be worth your consideration. AT&T's Safari NSX/20 Notebook Computer and the GRiD 1755, for instance, come standard with error-correcting and data-compressing internal modems. AT&T adds software that makes the hardware worthwhile, too: Every unit comes with *AT&T Mail Access Plus.* Microsoft Windows 3.0 was also included.

For the best battery life, we believe you should consider a 386SL or Am386SXL system. Besides the LTE Lite/25, both the AST Premium Exec 386SX/25 and the ZDS MastersPort 386SLe feature chips with low power consumption. Though our standard tests cannot measure how long an SL or SXL system can stay suspended in a sleep mode with one of these chips, we believe the systems' ability to shut themselves down during periods of inactivity will extend their usability greatly.

If a long battery life is your biggest concern, look at the Toshiba T4400SX, the AT&T Safari, and the AST Premium Exec. It doesn't matter how they got there (big batteries, a good design, or both); all three lasted for more than 4 hours on PC Magazine Labs' Battery Rundown test.

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Looking for a high-performance 14" color monitor for general business Windows™ and cost-effective CAD applications? Consider the new Diamond Pro 14 from Mitsubishi Electronics. It offers the 1024 x 768 non-interlaced maximum resolution for flicker-free 72 Hz compatibility required for Windows and other GUI environments.

The Diamond Pro 14 provides unparalleled clarity with its ultra-fine 0.28 mm dot pitch and operation versatility with a broad auto-scan range for all current high-refresh PC, PS/2™ and Macintosh® graphics standards. Its new design allows simple plug and play set-up. And it meets today's concerns for low magnetic emission.

For a Windows monitor that's easy on the eyes and easy on the pocketbook, the choice is clear: Diamond Pro 14. For more information, call Mitsubishi Electronics at 1-800-843-2515 or in Canada 1-800-387-9630.

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386SX NOTEBOOKS: RECENT REVIEWS

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ALR Venture/16	112
AST Premium Exec 386SX/20	125
Automated Computer Technology ACT Tempo 386SX	128
Bitwise 386SX/16 Notebook	136
Commax Notebook 386SX	112
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—Editors' Choice

notebook systems. Look for a system with a 60MB or 80MB hard disk. New 120MB disks should become more plentiful by midyear, and we believe you should strongly consider paying the $400 to $500 premium they command over 80MB systems. On any system, the minimum hard disk size you should accept is 40MB. Warehouses are full of unsold 20MB systems. If the hard disk you get turns out to be too small, you can double its capacity with an on-the-fly compression/decompression program, the best of which is Stac Electronics' Stacker 2.0. (For a review of four such programs, see "Double—No—Triple Your Hard Disk Space with On-the-Fly Data Compression Utilities," January 28, 1992.)

REVIEW CRITERIA

For this review, we looked for high-end battery-powered notebook systems. Specifically, we sought 20-MHz or faster 386 or 486 portable computers that weigh less than 7.5 pounds with batteries and have a footprint of no more than 9.5 by 12 inches. The systems had to be on the market as of January 1992. From the several dozen contenders, we chose 14 products that represent the leading edge of technology and those of greatest interest to notebook users.

Products selected for review are the AST Premium Exec 386SX/25, the AT&T Safari NSX/20 Notebook Computer, the Compaq LTE Lite/25, the Everex Tempo Carrier 386SX/20, the GRiD 1755, the Librex 386SX Notebook, the NEC UltraLite III, the NEC UltraLite SL/20, the Magnavox Metalis SX/20 (from Philips), the Philips LX320, the TI TravelMate 3000 WinSX, the Toshiba T2200SX, the Toshiba T4400SX, and the ZDS MastersPort 386SLe. We asked that they be configured with 4MB of RAM, a 60MB or 80MB hard disk, a high-density floppy disk drive, and DOS 5.0 (Version 4.01 or 3.3 was acceptable). The prices you see reflect these configurations.

A note: Most *PC Magazine* reviews are all-inclusive, covering all products in the category. This roundup is an exception. We will be devoting an entire issue to laptop reviews later this year (August 1992), timed to coincide with the more widespread availability of SL and SXL systems, color portables, and pen-based systems. This article is designed to tide you over until then.

In addition to the 14 systems we did test, we wanted to review several additional systems, but they were not shipping as of January. They include monochrome 386SLs from ALR, Toshiba, and Leading Edge, a color 386SX from Austin, and color 386SLs from ALR, Dell, Epson, Leading Edge, NEC, and Sharp. In addition, IBM recently announced the first of several new notebook products: the IBM PS/2 N51SX, a 6.2-pound 16-MHz 386SX (no CPU cache) with a 40MB hard disk, which will sell for a bit more than $2,000. Based on what *PC Magazine* saw of a near-production unit, we would say the unit is well designed in most respects but needs a bigger hard disk and a faster CPU to be competitive.

MORE AFFORDABLE, TOO

Intense price pressure lets you buy an SX-based notebook computer for $1,500 to $2,000 (street price) today, typically from companies with less-familiar names than the brands represented here. For that price, you will probably get a smaller hard disk (20MB or 40MB) and only 1MB to 2MB of RAM. You should be able to buy the systems reviewed here for just over $2,000 to more than $4,500, depending on the discount structure of the brand. These 14 notebooks have list prices between $3,000 and $5,750 in their *PC Magazine* configuration (4MB of RAM, a 60MB hard disk, and DOS). The par for high-end notebooks is the Toshiba T2200SX, currently at $3,999 list and selling for a bit over $3,000. Compaq undercut Toshiba a bit on price—at $3,798 for the 25-MHz version (LTE Lite/25), $500 less for a 20-MHz version (LTE Lite/20) with 2MB of RAM. Note, however, that Compaq has again squeezed its dealer margins a bit

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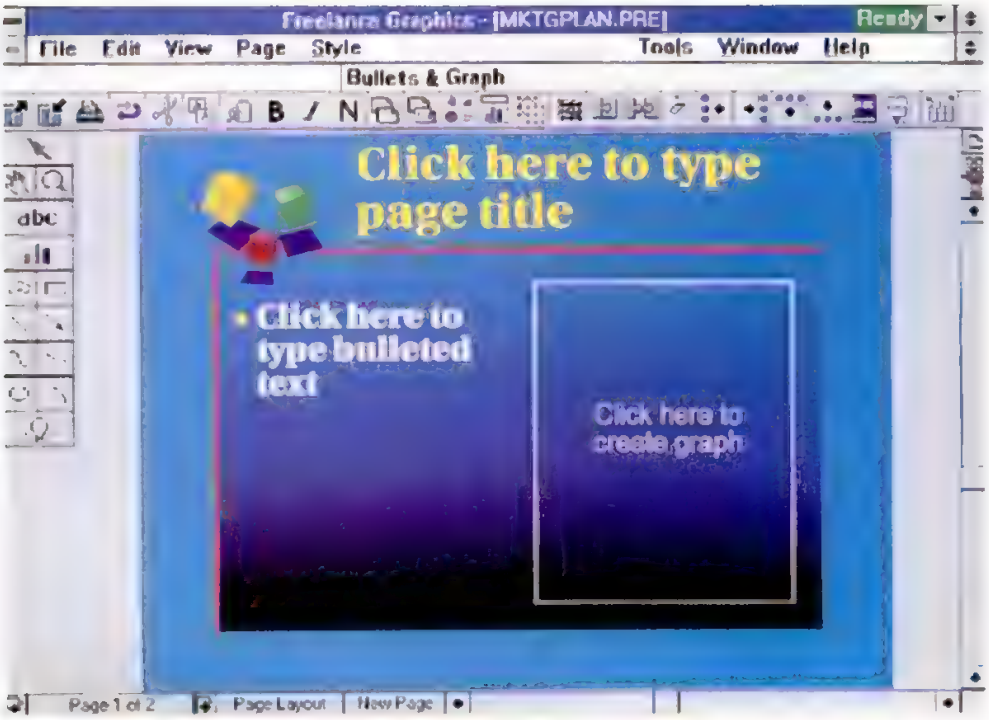

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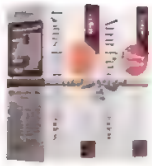

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more in order to keep the street price as close as possible to list price.

Expect the prices of many of these 14 systems to drop as the market absorbs the impact of the new Compaq systems and as Toshiba repositions. (Days after Compaq began shipping, for instance, Zenith Data Systems dropped the price of its MastersPort from $5,247 to $4,398 for the configuration we tested.) Vendors can also adjust the price of systems with factory-to-dealer incentives (just like automobiles) that cut the selling price without cutting the list price. Cheaper CPU chips will bring prices down, too, and Intel is even pondering a 16-MHz SL system. By the end of this year, virtually all laptop makers, not just the lesser-known brands, should have 386SX systems that sell for less than $2,000 each.

AST RESEARCH INC.

AST Premium Exec 386SX/25

A long battery life and a fast, 25-MHz Am386SXL processor made the AST Premium Exec 386SX/25 one of the performance leaders among the 14 notebooks we reviewed. Slightly heavier and just a bit bulkier than some of its counterparts, the 7-pound Premium Exec has a sound, sturdy design and is backed by AST Research's excellent reputation.

Our $3,295 test unit came with 4MB of RAM, an 80MB hard disk, and a 1.44MB floppy disk drive. (A 60MB version sells for $300 less.) When you open the 2.5- by 11.5- by 9-inch case (HWD), a cover plate above the top row of keys slides off effortlessly, letting you add RAM ($999 for a 4MB SIMM chip that expands RAM to its 8MB limit), an 80387SX coprocessor, and a modem. Modem options include a 2,400-bps data-only unit ($249), a data-only 9,600-bps send-fax unit ($349), or the one installed in the unit we tested: a data- and 9,600-bps send/receive-fax ($499) modem.

The Premium Exec's keyboard takes advantage of the notebook's bulkier size; the full-size keys include dedicated cursor and position keys. The 8.5-inch screen, a paper-white LCD that uses cold-cathode fluorescent tube (CCFT) technology, displays 32 shades of gray. Contoured edges, a firm and wobble-free hinge, and a sturdy front spring-latch underscore the Premium Exec's rugged design.

Except for the RJ-11 jack, all external connectors (power, keyboard or PS/2-style mouse, one parallel and one serial port, and monitor) are located behind a flip-down panel on the rear of the case. The 1.44MB floppy disk drive loads from the front, avoiding potential interference with any side-mounted pointing device.

Thanks to the 25-MHz AMD Am386SXL, the Premium Exec's processor and memory scores were among the best of this group. Its disk performance was among the top four, but its Cirrus Logic video subsystem was disappointing: Despite 256K of video RAM, results fell below average for both the DOS and Windows video tests.

The 1.3-pound nickel cadmium battery yielded one of the best rundown times we saw: 4 hours 6 minutes. Since the battery slides into a compartment behind a hinged door on the right side of the case, there is no need to turn the unit upside down and no cover plate to drop or misplace. A 10-ounce 115/230-volt autosensing AC adapter recharges the notebook in 3 to 5 hours with the power off but takes almost three times as long with the power on. An external battery charger costs $119, an automobile adapter/battery charger, $129.

PC LABS BENCHMARK TESTS

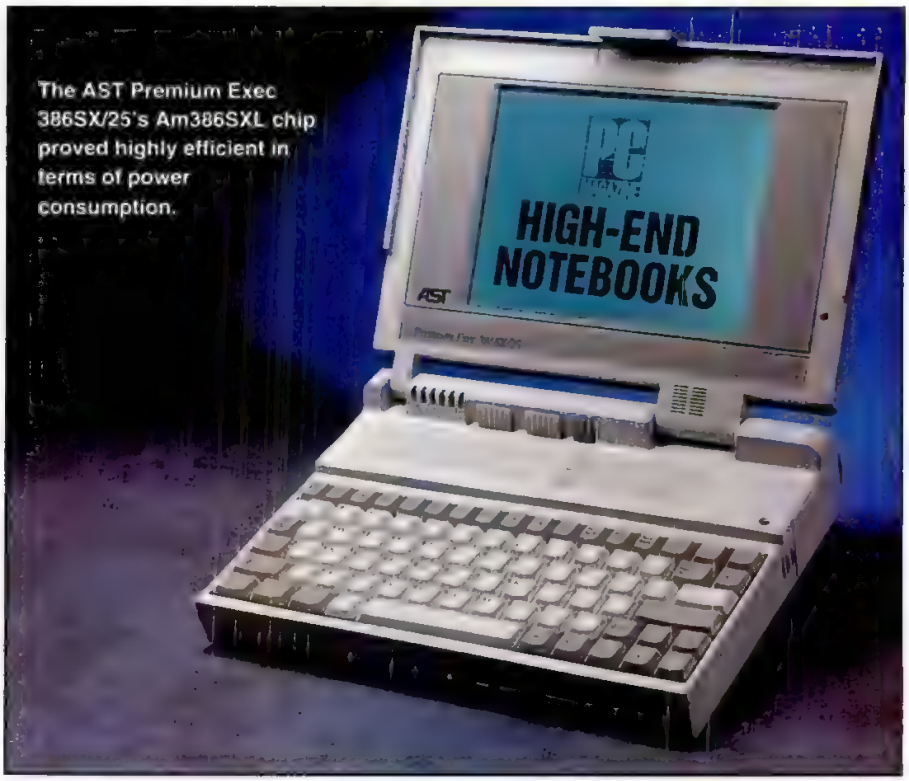
AST Premium Exec 386SX/25

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	111	87	263	111
Memory	2,188	1,396	4,795	2,162
Disk (seeks/second)	156	130	244	157
Video	721	478	3,030	1,286
Windows Graphics	969	745	2,175	1,273

In Short: A power-conscious Am386SX chip gives the 7-pound AST Premium Exec 386SX/25 a superb battery life; the 25-MHz rating pushed its processor and memory performance well ahead of the 386SX/20s we reviewed. At $3,445, this system is also among the better buys. **Battery Life:** 4 hours 6 minutes.

The Premium Exec enters a suspend mode when you close its cover, and it returns to full operation when you open it again. Alternatively, you can establish intervals in setup that initiate suspend mode, video and hard disk time-outs, and turbo mode. AST's optional power-management software driver reduces power consumption under Windows in 386 Enhanced mode, but you don't need it to run Windows.

AST sells through authorized resellers and offers a standard one-year warranty



The AST Premium Exec 386SX/25's Am386SXL chip proved highly efficient in terms of power consumption.

FACT FILE

AST Premium Exec 386SX/25
AST Research Inc., 16215 Alton Pkwy., P.O. Box 19658, Irvine, CA 92713-9658; 714-727-4141.
List Price (tested configuration): $3,295.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
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on parts and labor. Along with an 800 number for technical support, a bulletin board service, and a fax line, AST offers a 24-hour Execare service that costs $45 during the first year. An extended warranty is available.—*Alan M. Stoughton*

AT&T/MARUBENI AMERICA CORP.

Safari NSX/20 Notebook Computer

Besides being the most stylish system of the group, AT&T's Safari NSX/20 Notebook Computer is among the best equipped for communications. Geared for business and travel, this 386SX/20 notebook comes standard with a built-in cellular-capable fax modem and also offers an optional cellular-phone attachment.

The $5,749 Safari's sophisticated design is actually practical: Rounded edges keep the case from catching; raised, bumper-like strips on the sides add a bit of shock absorption. The keyboard color scheme makes keys easier to see. Our 7.3-pound test model, which measured 1.8 by 12 by 9.5 inches, had 4MB of RAM (expandable to 8MB with a memory card), an 80387SX coprocessor socket, and an 80MB Conner hard disk. The price also includes Windows 3.0, a data and fax modem, AT&T's communications accessories, a mouse, an AC power adapter, and a carrying case; all these things are standard with every system.

The built-in error-correcting modem has 9,600-bps send/receive fax capabilities. Connectors include two RJ-11 jacks for the phone and modem lines, a CRT interface, one parallel and two serial ports (one serial port is dedicated to the modem), and a combination mouse/keyboard port. To use the Safari's unique cellular-phone option, you need AT&T's AXSYS, a smart cellular interface. Plug one side of the AXSYS device into the Safari's fax modem and the other into an AT&T, OKI, or NEC cellular phone and the fax modem will send and receive data over a cellular-phone network as if it were transmitting over a standard phone line.

The Safari's 10-inch triple-supertwist LCD shows 32 shades of gray at VGA resolution; it has electroluminescent backlighting and a nonglare surface. A cutout below the screen makes the system status window viewable with the cover closed. A control-panel pop-up utility lets you change major system settings on the fly.

The Safari's power management offers some unique features in addition to the standard ones. A custom-design feature steps the CPU down to 2 MHz if no keyboard activity occurs within a user-specified time; an owl's eye indicator in the status window shows the CPU speed. At the same time, special ASICs (application-specific integrated circuits) monitor the active status of I/O subsystems such as video and disk to ensure that the CPU speed does not slow down during processing just because the keyboard is inactive. These features are supplemented by standard suspend/resume mode; video and disk time-outs; and modem, speaker, and serial-port power-down.

The Safari's outstanding battery life—4 hours 6 minutes at full power—comes from a 1.6-pound battery pack that has a 6-hour recharge time. Since the battery pack consists of two separate batteries, you can replace one during operation without system power-down.

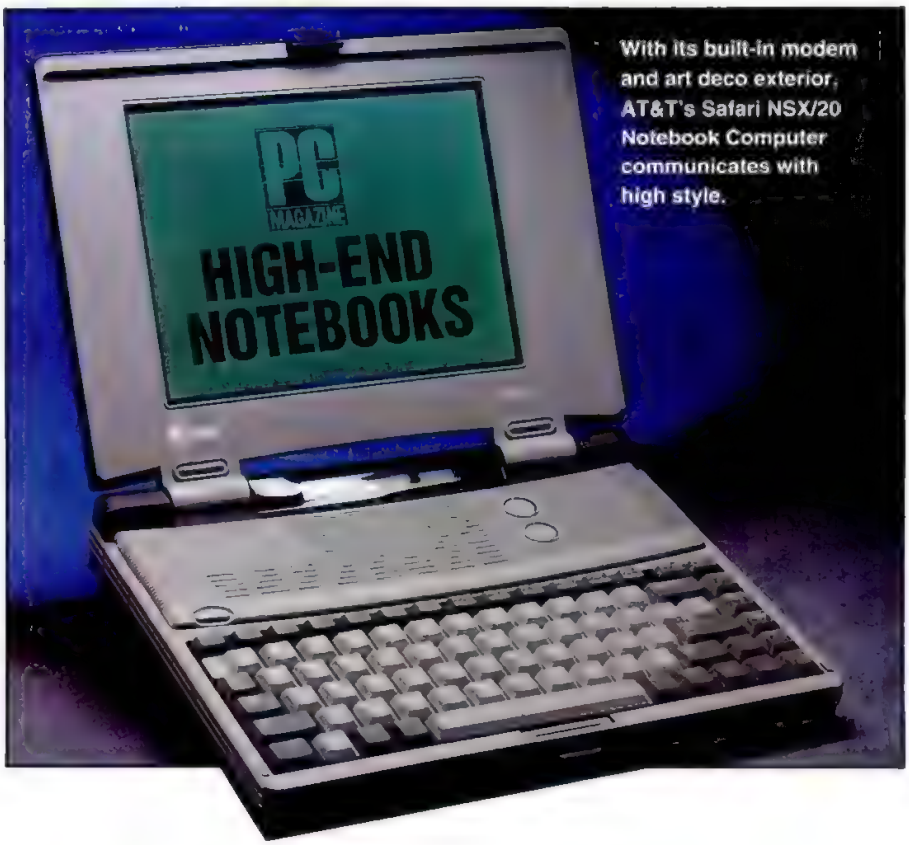
On our benchmark tests, the Safari's disk performance was on the slow side of average. Its processor and memory per-

PC LABS BENCHMARK TESTS 6.0

AT&T Safari NSX/20

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	91	87	263	111
Memory	1,677	1,396	4,795	2,162
Disk (seeks/second)	135	130	244	157
Video	478	478	3,030	1,286
Windows Graphics	745	745	2,175	1,273

In Short: True to its roots, AT&T has made the high-style, 7.2-pound Safari NSX/20 Notebook Computer a top-notch communicator. Equipped with a built-in modem, the company's own communications software, and even cellular-phone capability, this $5,749 386SX/20-based PC should satisfy any busy traveler.
Battery Life: 4 hours 6 minutes.



With its built-in modem and art deco exterior, AT&T's Safari NSX/20 Notebook Computer communicates with high style.

Specialties Of The House
Hot Computers.
50's Prices.
Fabulous Service.
GATEWAY2000

Serving PCs

Come On In.

With The Works!

This ad was photographed at Archie's Diner in Sioux City, Iowa. Archie is behind the counter. Other characters are Gateway 2000 employees from departments throughout the company.

Folded edge of the page

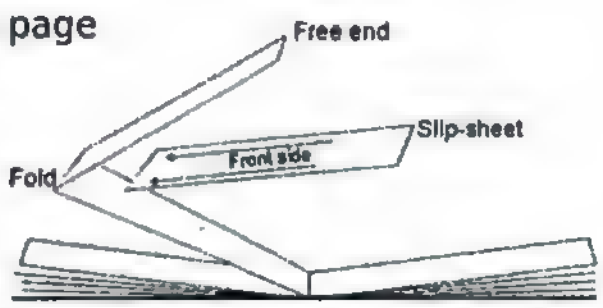
GbsSlipSheet-001

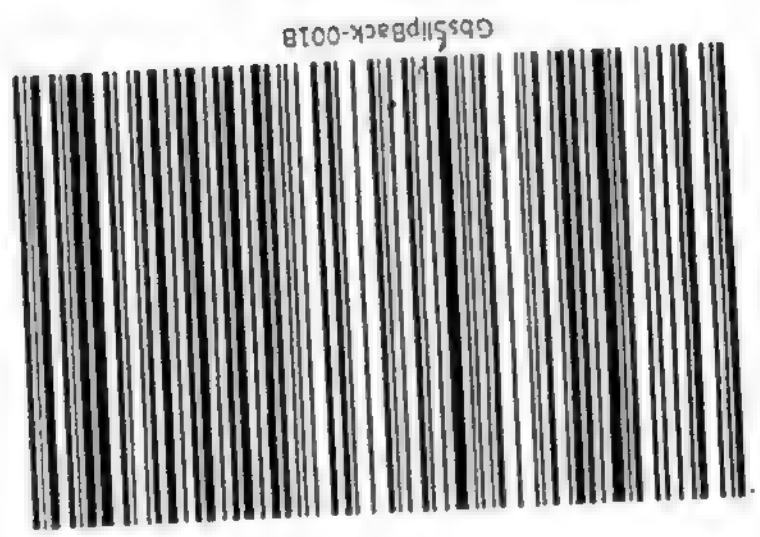
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

Gateway Cafe

What comes to mind when you picture the classic 50's diner?
Good food and plenty of it. Great service.
And the price on the check is remarkably affordable.

When you buy a personal computer from Gateway 2000, the experience has its similarities. You get a solid quality, high-performance computer that comes fully loaded with all the features you want. The service is unsurpassed anywhere. And the price you pay is also remarkably affordable.

You get a lot for your money at Gateway. And now you get even more. We're offering free application software with every system. Not just one or two popular programs either. You can choose from a smorgasbord of scrumptious software, prepared for use with Windows,™ and one selection comes free with your Gateway 2000 computer. We have new peripherals, too, including the Gateway TelePath™ – a 14,400 bps modem with 9,600 bps fax capability. The Gateway TelePath with WinFax Pro™ and Crosstalk® for Windows is only $195.

Go ahead and browse through the Gateway Cafe menu. We serve a wide selection of the freshest items in the PC industry. You're sure to find something that will appeal to your taste and budget.

GATEWAY2000

You've got a friend in the business

Copyrighted material

Feast Your Eyes On This New

Gateway 2000's 486DX2/50 systems, ISA and EISA, are based on the new Intel486™ DX2 dual speed microprocessor. The internal core of this processor executes at twice the speed of the external memory bus. With a system clock frequency of 25MHz, the CPU processes instructions at 50MHz for a 35% increase in performance compared to a 33MHz 486DX system.

NEW

486 Features

Like all 486 processors, the DX2 is a 32-bit architecture CPU, which includes a coprocessor, a floating point unit, an 8K cache and dual data and instruction paths for execution of many instructions in a single clock cycle. And because the DX2 runs on a 25MHz motherboard, one of the industry's most stable boards, these systems are extremely reliable.

ISA System Bonus

The ISA version of the 486DX2/50 includes two bonus features we think you'll appreciate. This system comes standard with ATI's™ Graphics Ultra 1024 x 768 video card. The Graphics Ultra, described in more detail on the next page, is over 11 times faster than standard VGA. With the Ultra as a standard component, this machine performs a lot like a graphics workstation.

486DX2 Special

Increased IDE Performance

We also included enhancements to our IDE technology that we've dubbed RIDE (Rapid Integrated Drive Electronics). Although it's still an IDE drive, with full IDE compatibility, the RIDE technology takes advantage of our new system BIOS that allows the drive to transfer up to 16 blocks of data instead of 1 block. You'll notice a performance improvement in many applications and file operations.

Price

We usually suggest you compare Gateway's features and prices with what other manufacturers are offering, but in this instance you won't find many DX2 systems on the market yet. We've worked closely with Intel® on this introduction, allowing Gateway 2000 to be among the first to offer this new technology. But unlike other manufacturers that strive to be first to market with a product, Gateway offers you new technology at a great price. Gone are the days when you either had to pay too much or wait too long to own the very best. With Gateway 2000, you really can have your cake and eat it, too!

50MHz 486DX2

- Intel 80486DX2 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE* Drive with 64K Multi-Segmented Cache
- ATI™ Ultra 8514/A Video with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft® Mouse
- MS® DOS® 5.0
- MS Windows™ 3.0
- Choice of Application Software

$3195

*Enhanced IDE with RIDE (Rapid Integrated Drive Electronics) technology

50MHz 486DX2 EISA

- Intel 80486DX2 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 340MB 15ms SCSI Drive with 128K Multi-Segmented Cache
- 32-Bit EISA SCSI Controller
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$4095

GATEWAY2000

"You've got a friend in the business"

Gateway Cafe

New Options To Go With Your

The Gateway TelePath™ Fax/Modem

For $195, you get the Gateway TelePath – a new custom-designed V.32bis modem with 9,600 bps fax capability plus WinFax Pro,™ Crosstalk® for Windows™ and a free 30-day subscription to CompuServe® Basic Services. Anywhere else you'd pay more for the software alone!

The Gateway TelePath modem operates up to 14,400 bps. The modem is compatible with the standard AT command set, and is downwardly compatible with lower modem speeds. You'll connect reliably using data compression and error correction whether you're sending/receiving to the next office or the next continent. With the Gateway TelePath fax, you can send to or receive from any Group 3 or earlier fax machine using Class 1 or Class 2 commands.

You'll find comparable fax/modem packages can cost in excess of $500 not including the software. At $195, the Gateway TelePath price is very easy to swallow.

$195

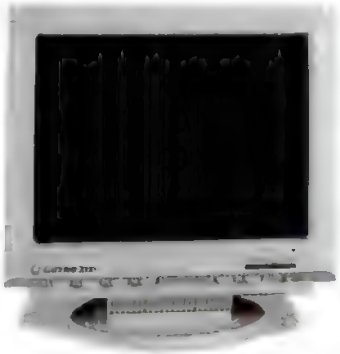
- Automatic speed sensing
- Programmable speaker volume control
- Fax mode: V.17, V.29, and V.27ter
- Data mode: (try to find one we don't support!) V.32bis, V.32, V.22bis, V.22, V.21, Bell 212A and 103, V.42 and MNP 2-4 error correction, V.42bis/MNP 5 data compression

Gateway 2000 PC

The 15-Inch Crystal Scan 1572FS

It's bigger, but that's just one of the improvements we've made to the 15-inch Crystal Scan 1572FS. The new flat, square, non-glare screen reduces distortion around the corners and provides an edge-to-edge display area. At 1024 x 768 resolution, the non-interlaced Crystal Scan 1572FS has a higher 72Hz refresh rate for added image stability and flicker-free display. The 1572FS will support resolutions up to 1280 x 1024, which prepares you for the future when this resolution becomes a standard. We've also moved the fine tuning controls to the front of the monitor for easy access.

The Crystal Scan 1572FS is an option with 386DX and 486 systems for an additional $195. Availability is limited.

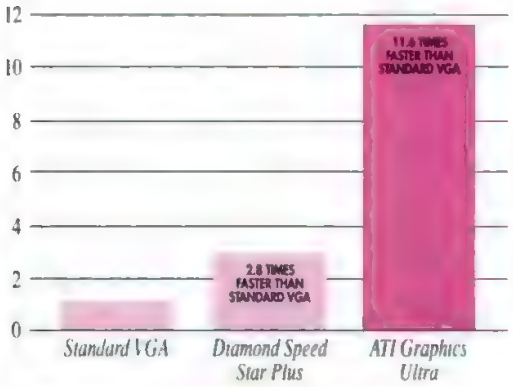


Crystal Scan 1572FS

The ATI™ Graphics Accelerator

You're really cookin' when you run a Gateway 2000 system with ATI's graphics accelerator, the Graphics Ultra. ATI achieves a quantum leap in performance by using a highly optimized graphics coprocessor. The 1024 x 768 mode is fully compatible with IBM® 8514/A, VGA, Super VGA and previous IBM graphics standards, which makes it easy to install applications using standard video drivers.

The ATI Ultra video card is standard with the 486DX/33 system, optional with all other 386DX and 486 systems. The street price of this card is over $500, but with the purchase of a Gateway 2000 system, you can upgrade to it for $150.



Figures computed on a 486DX/33 and provided by ATI Technologies Inc.

Peripherals and options are sold only with the purchase of a system. If you already own a Gateway 2000 computer, you can buy them separately. Please have your customer ID handy and ask for the sales upgrades and add-ons department when you call. Availability is limited.

GATEWAY2000

"You've got a friend in the business."

Gateway Cafe

Choose One Software Option Free With

With the purchase of any Gateway 2000 computer system, you now receive your choice of free application software. Pick one from the seven application options in our software buffet. We'll install one software option on your hard drive, optimally configured for your system and Windows,™ and provide you with the master diskettes and manuals – absolutely free.

You can also buy additional software at extremely competitive prices, or choose from other popular applications not listed here. Ask your sales person for details.

Option #1

Microsoft Excel for Windows™ 3.0

- A powerful graphical spreadsheet program
- Includes online help for Lotus® 1-2-3® users
- *PC Magazine's* Editor's Choice

Retail value: $495. Discount value: $300+.
Can be yours free with a Gateway PC!

Option #2

Microsoft Word for Windows™ 2.0

- Best selling word processor for Windows
- New version 2.0 adds spectacular refinements
- Includes online help for WordPerfect® users

Retail value: $495. Discount value: $300+.
Can be yours free with a Gateway PC!

Option #3

Microsoft PowerPoint for Windows™ 2.0

- Easy-to-use desktop presentations program
- Creates high-quality overheads and 35mm slides

Retail value: $495. Discount value: $300+.
Can be yours free with a Gateway PC!

Option #4

Paradox® 3.5

- Award-winning database management program
- From Borland,® the leader in customer satisfaction for database and programming software

Retail value: $695. Discount value: $500+.
Can be yours free with a Gateway PC!

Gateway Cafe

Your Gateway 2000 PC!

Option #5

The Entrepreneur Pack

Includes Microsoft's Works,™ Publisher™ and Money,™ the latest versions, and an Entertainment Pack, all for Windows, plus TurboTax for Windows™ from ChipSoft

- Works integrates a word processor, spreadsheet, database and more into one easy-to-use program
- Publisher has page layout tools to create publications
- Money helps you control your finances by writing checks, setting budgets, tracking expenses
- Entertainment Pack, eight games including Tetris
- TurboTax is an easy-to-use tax preparation program with online help for understanding IRS rules

Retail value: $607. Discount value: $400+. Can be yours free with a Gateway PC!

This offer includes the identical applications contained in retail packages but will not include the retail box. You get a complete set of diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.

Option #6

The Windows Programmer Pack

Includes Microsoft's QuickC for Windows,™ Visual Basic for Windows,™ Windows Control Development Kit,™ MS Windows Help Compiler™ and MS Windows Programmer's Online Reference™

- Everything you need to create programs for Windows

You can't buy all of these tools in one package elsewhere, but this option can be yours free with a Gateway PC!

Option #7

Microsoft Project for Windows™ 3.0

- Flexible and easy project management program
- Includes interactive online tutorial
- *PC Magazine* calls it the best program in its category

Retail value: $695. Discount value: $425+. Or free with a Gateway PC!

If the free software packages offered here don't suit your needs, we have others that are very competitively priced. For example, if you'd rather get Microsoft Office,™ which includes Word for Windows, Excel and PowerPoint, you can upgrade to it. Office retails for $750, with a discount value of $499. It can be yours for only $175 with a Gateway PC. Ask your sales representative for details.

GATEWAY2000

You've got a friend in the business

Desserts SOFTWARE

There's A PC Here That's Just What You're

486DX And DX2 Systems

Gateway 2000's 486 systems, including the new 50MHz 486DX2 machines, run on the real McCoy – Intel486™ microprocessors. All 486 CPUs are 32-bit architecture and include a math coprocessor and an 8K instruction cache.

The ISA systems have a Micronics® motherboard, while the motherboard for the EISA systems is custom-manufactured for Gateway 2000. RAM is expandable to a system total of 64MB.

New on the ISA models is the ATI™ Graphics Ultra video card, which is the fastest video card by far in its class. The EISA systems include a Diamond Speedstar Plus,™ which is also a high-performance video card. All 486 systems come with 1MB video RAM.

The Micronics motherboard in the ISA systems has eight 16-bit slots, six of which are available in the standard configuration. The EISA machines have eight 32-bit slots on the system board, five of which are open in our standard configuration. The ISA systems have Phoenix® BIOS, while the EISA models use Award™ BIOS. All 486 systems come with Weitek sockets and 200 watt power supplies. These systems come standard in a desktop model. A tower model is an option for an additional $100.

33MHz 486DX Our best selling system, the 486DX/33, is now even better with the addition of the ATI Graphics Ultra video card. We use this system in our technical publications department where we produce 600-plus-page manuals, and the DTP people love it. That must be why *Computer Shopper* readers chose the 486DX/33 as the 1991 Best Buy in 486 desktop systems. The 486DX/33 comes with 8MB RAM and a 200MB IDE drive. **$2945**

The tower model is an option for 386DX & 486 systems.

50MHz 486DX2 Based on Intel's® new 486DX2 microprocessor, this ISA system features a dual speed CPU. The internal speed of the processor is 50MHz, while the external memory bus operates at 25MHz. This speed-

Hungry For

doubling technology allows you to have the power of a 50MHz system at a midrange price. Our standard configuration includes all the popular features found on our 33MHz 486DX model, plus a 200MB IDE drive that takes advantage of RIDE (Rapid Integrated Drive Electronics). **$3195**

33MHz 486DX EISA With the 486DX/33 EISA, you can take advantage of Extended Industry Standard Architecture, capable of running the latest technology 32-bit boards, at an affordable price. If you're concerned about keeping up with technology, choosing EISA may be a smart move. This system includes a 32-bit EISA SCSI controller, an expensive option with most EISA computers, 8MB RAM and a hefty 340MB SCSI drive. **$3895**

50MHz 486DX2 EISA With the same dual speed processor described in the ISA model, this system also includes the same features as our 33MHz 486DX EISA model. The only difference is the increased performance of the CPU. **$4095**

NEW

386DX Systems

The 386DX systems have a true 32-bit memory bus and excellent expansion capabilities. We start with a genuine Intel 80386 microprocessor on a Micronics motherboard. We add a generous portion of RAM – 4MB expandable to a system total of 64MB. Add IDE hard drives from Western Digital,® Diamond Speedstar Plus 16-bit VGA graphics cards with 1MB RAM, supporting up to 1024 x 768 non-interlaced resolution, 14-inch Crystal Scan non-interlaced 1024 x 768 color monitors, Phoenix BIOS, a Weitek socket on the 386DX/33, and 200 watt power supplies. That's the basic recipe for these tried-and-true workhorse computers.

Both systems have a 32-bit slot open in the standard configuration for RAM expansion. The motherboard has a total of one 32-bit and seven 16-bit slots, with one 32-bit and five 16-bit expansion slots available in the advertised configuration. These systems come in a desktop model that is roomy and easily accessible. A floor-standing tower model is an option for an additional $100.

25MHz 386DX The 386DX/25 is one of our most popular systems because it's a good Windows machine and has plenty of power for most users' needs at a price that's very affordable. This system comes with 4MB RAM and an 80MB hard drive. **$1895**

33MHz 386DX The 386DX/33 was chosen as the Best Buy of 1991 for 386 desktop systems by the readers of *Computer Shopper* magazine. It's easy to see why. This is a powerful system, with 4MB RAM, 64K cache RAM and a roomy 200MB hard drive, at a price that's hard to beat. **$2395**

Gateway Cafe

16MHz 386SX

- Intel® 80386SX Processor
- 2MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 40MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey™ Keyboard
- Microsoft® Mouse
- MS® DOS® 5.0
- MS Windows™ 3.0
- Choice of Application Software

$1445

20MHz 386SX

- Intel 80386SX Processor
- 32K Cache RAM
- 4MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 80MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$1745

25MHz 386DX

- Intel 80386 Processor
- 4MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 80MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$1895

33MHz 386DX

- Intel 80386 Processor
- 64K Cache RAM
- 4MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$2395

33MHz 486DX

- Intel 80486 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE Drive with 64K Multi-Segmented Cache
- ATI™ Ultra 8514/A Video with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$2945

50MHz 486DX2

- Intel 80486DX2 Processor
- 64K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 200MB 15ms IDE* Drive with 64K Multi-Segmented Cache
- ATI Ultra 8514/A Video with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$3195

**Enhanced IDE with RIDE (Rapid Integrated Drive Electronics) technology*

33MHz 486DX EISA

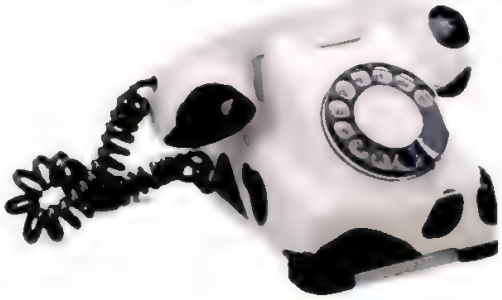
- Intel 80486 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 340MB 15ms SCSI Drive with 128K Multi-Segmented Cache
- 32-Bit EISA SCSI Controller
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$3895

50MHz 486DX2 EISA

- Intel 80486DX2 Processor
- 128K Cache RAM
- 8MB RAM
- 1.2MB 5.25" Drive
- 1.44MB 3.5" Drive
- 340MB 15ms SCSI Drive with 128K Multi-Segmented Cache
- 32-Bit EISA SCSI Controller
- 16-Bit VGA with 1MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0
- Choice of Application Software

$4095



BEST BUYS

- Get our 33MHz 386DX system, same configuration as listed, with a 120MB IDE hard drive instead of the 200MB drive.

$2145

- Same features as our 33MHz 486DX system except this machine has 4MB RAM instead of 8, and a 120MB IDE hard drive instead of the 200MB drive in our standard configuration.

$2495

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CST)
Service Hours: 6am-Midnight Weekdays, 9am-2pm Saturdays (CST)

All prices are subject to change. Prices do not include shipping.

intel inside

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800-523-2000

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SUMMARY OF FEATURES

List price (*PC Magazine* configuration) To facilitate comparison, we are citing prices for similarly equipped machines. The configuration we requested for the 14 386SX notebooks includes 4MB of RAM, a 60MB or 80MB hard disk, a VGA display subsystem, DOS 5.0 or 4.01, and an AC power adapter.

Processor type and speed In this review, we tested Intel 386SX/20s, 386SL/25s, a 486SX/25, and an Am386SXL/25.

Distribution channel Some machines are sold directly through mail order, others through dealers. Dealers have previously offered discounts of 25 percent or more off the list price; however, an industry-wide price restructuring has cut these discounts in many cases. *PC Magazine* views a 15 percent discount as typical.

Weight (pounds) The table indicates the combined weight of the notebook and battery.

Motherboard manufacturer Some machines are based on motherboards made by major manufacturers, although their other components may vary.

Chip set manufacturer indicates which company makes the logic that connects the CPU with the other functions managed by the system board. Chip sets that use VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps reduce power consumption and increase component life.

The **BIOS version (or date)** can affect PC Magazine Labs' benchmark test results. A machine with a different BIOS may perform differently.

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up. Shadowing uses RAM located between 640K and 1MB.

Installable RAM indicates the amount of memory that can be installed in the unit.

Proprietary expansion port Some machines have an expansion port that enables the system bus to be connected to external devices, such as an expansion station or external floppy disk drive.

Expansion slots refers to machine-specific slots most commonly used by modems and memory modules. Sometimes the slots can also be used for network adapters or fax modems. **User-accessible** means the user can add cards to this slot rather than shipping the unit to the dealer or manufacturer. Some systems also feature a **PCMCIA slot**—a socket that accepts credit-card–size devices such as modems and RAM cards. (PCMCIA is the Personal Computer Memory Card International Association.)

An **expansion unit,** also called a docking station or expansion station, provides additional space for standard expansion cards and hard disks, tape drives, or floppy disk drives.

Screen manufacturer Most vendors purchase liquid-crystal displays from outside sources.

Video chip set manufacturer indicates which company makes the video logic that drives the LCD screen and any external monitor hookup.

The **keyboard** section shows the **total** number of keys, the number of **function** keys (10 or 12), and the number of **cursor** keys (4 or 8). If you have only 4 cursor keys and you need to access PgUp, PgDn, Home, or End, you must hold a function key and tap one of the arrow keys—an inconvenient extra step. This section also shows whether or not the notebook has an external numeric **keypad connector** and/or an external **keyboard connector**.

Software refers to any programs bundled with the system, free of charge. (The *PC Magazine* configuration includes DOS 5.0—or, if it is not available, DOS 4.01—to allow more accurate price comparisons.)

Internal modem options includes the functions and compression schemes of the vendor's modem options. Unless otherwise noted, data modems run at 2,400 bits per second and fax modems at 9,600 bps. Such fast modems benefit from built-in data compression and error correction. *MNP 5 compression* is the most widespread form of data compression in use and includes MNP 2 through MNP 4 error correction. *V.42 error correction* is an emerging standard, as is *V.42bis compression,* which includes V.42 error correction and MNP 5 compression. Whenever possible, you should consider MNP 5 compression as a minimum requirement.

AC adapter voltage All notebook PCs in this review come with dual-voltage AC adapters.

The **AC adapter weight** and **size** can vary significantly among machines with similar power needs.

Rated battery life is the vendor's rating for the internal battery or batteries, measured in hours. PC Labs independently measures the **tested battery life.** We also rated the **charge time** with the unit on and off, as reported by the vendors.

The **battery amp/hour rating** shows how long a battery is rated to deliver a steady number of amperes per hour.

Power conservation in BIOS includes such features as automatic display dimming or blanking, automatic hard disk shut-off (now common to most portables), slowing or halting the CPU, and removing power from I/O ports (modem and serial ports) when the machine is not in use.

The **FCC Class B identification number** refers to the Federal Communications Commission's certification number, which shows that an electronic device has sufficiently low radio-frequency emissions to be used in the home. Portable PCs must have a Class B certification and an identification number. To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service, at 301-725-1072.

CONTINUES

SUMMARY OF FEATURES

Products listed in alphabetical order by company name

PC—Editors' Choice
■—Yes ❑—No

	AST Premium Exec 386SX/25	AT&T Safari NSX/20 Notebook Computer	Compaq LTE Lite/25	Everex Tempo Carrier 386SX/20	GRiD 1755	Librex 386SX Notebook
List price (*PC Magazine* configuration)	$3,295	$5,749	$4,298	$3,395	$4,090	$3,299
Processor type and speed	Am386SXL/25	386SX/20	386SL/25	386SX/20	386SX/20	386SX/20
Hard disk capacity	80MB	80MB	80MB	80MB	80MB	40MB
Distribution channel	Dealers	Dealers, direct	Dealers	Dealers	Direct	Dealers
STANDARD CONFIGURATION						
Dimensions (HWD, in inches)	2.5 x 11.5 x 9	1.8 x 12 x 9.5	1.8 x 11 x 8.5	1.8 x 8.5 x 11	1.7 x 12.2 x 10	2 x 11.5 x 8.5
Weight (pounds)	7	7.3	6	5.2	5.2	6.3
Display area (H x W, in inches)	5 x 6.8	8.1 x 6.1	5.7 x 7.6	5.3 x 7.1	5.3 x 7	5.8 x 7.5
Motherboard manufacturer	AST	Matsushita	Compaq	Everex	Tandy	Nippon
Chip set manufacturer	WD	Intel	Intel	C&T	Intel	C&T
BIOS version (or date)	AST 1.1	Phoenix A386 v1.01	Compaq 1/20/92	AMI GZ-A33	Phoenix 3.10	Award 3.0
Setup in ROM/Password in ROM	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
System shadowing/Video shadowing	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
MEMORY AND DISK DRIVES						
Installable RAM	4MB–8MB	4MB–8MB	4MB–10MB	2MB–8MB	2MB–8MB	4MB
User-installable	■	■	■	❑	■	❑
Processor RAM cache installed	None	None	16K	N/A	❑	❑
INPUT/OUTPUT						
Parallel, serial, mouse ports	1, 1, 1	1, 2, 1	1, 1, 1	1, 2, 1	1, 1, 1	1, 2, 0
Proprietary expansion port	❑	■	■	❑	❑	❑
EXPANSION BUS						
Expansion slots	1 memory, 1 modem	1 memory	1 modem	3 memory, 1 modem	1 memory	None
User-accessible	■	■	■	❑	■	N/A
PCMCIA slot	❑	❑	❑	❑	❑	❑
Price of expansion unit	N/A	N/A	$929	N/A	N/A	N/A
VIDEO						
Screen manufacturer	Epson/Sanyo/ Sharp	Sharp	Citizen	Sharp	N/A	Seiko
Video chip set manufacturer	Cirrus	Cirrus	Proprietary	C&T	Cirrus	WD
Simultaneous external display	❑	❑	■	❑	N/A	❑
KEYBOARD						
Keys: total, function, cursor	82, 10, 4	82, 12, 4	80, 10, 8	80, 10, 4	84, 12, 4	82, 12, 4
Keypad connector/ Keyboard connector	■ / ■	■ / ■	■ / ■	❑ / ■	■ / ■	❑ / ❑
SOFTWARE						
DOS	5.0	5.0, 4.01	5.0	5.0	5.0	5.0
Other software	*Super PC-Kwik*	*AT&T Mail, BitFax*, Microsoft Windows 3.0, *Windows Productivity Pack*	Utilities	Microsoft Windows 3.0	None	None
MODEM						
Internal modem options	Data-only ($249), send-only fax ($349), send/receive fax ($499)	V.42bis data/fax (included)	V.42bis data-only ($319), 9,600-bps V.42bis data-only ($599)	2,400-bps data/ 9,600-bps send-fax ($329)	V.42bis data/fax (included)	Data-only ($249), data/fax ($429)

N/A—Not applicable: The product does not have this feature.
C&T—Chips and Technologies Inc., WD—Western Digital.

NEC UltraLite III	NEC UltraLite SL/20	Philips Magnavox Metalis SX/20	Philips LX320	TI TravelMate 3000 WinSX	Toshiba T2200SX	Toshiba T4400SX	ZDS MastersPort 386SLe
$3,298 386SX/20 60MB Dealers	$3,799 386SL/20 80MB Dealers	$3,398 386SX/20 64MB Dealers	$3,698 386SX/20 80MB Dealers	$3,599 386SX/20 80MB Dealers	$4,778 386SX/20 60MB Dealers	$6,034 486SX/25 80MB Dealers	$4,398 386SL/25 85MB Dealers, direct
1.5 x 11.5 x 9 4.7 9 x 4 NEC WD Phoenix 1.01 ■ / ■ ■ / ■	2.2 x 11.5 x 9 6.3 5.8 x 7.7 NEC Intel Phoenix 1.01 ❑ / ■ ■ / ■	2 x 11 x 8.5 7.4 6.9 x 5.1 Philips Headland Award 3.0 ■ / ■ ■ / ■	1.8 x 11 x 9 6.4 7.8 x 5.9 Philips Headland Award 3.0 ■ / ■ ■ / ■	2 x 11 x 9 7.1 6 x 8 TI Intel Phoenix A.1.30 1.11 ■ / ■ ■ / ■	1.6 x 11.7 x 8.3 5.6 5.7 x 7.6 Toshiba Intel Phoenix 1.20 ■ / ❑ ■ / ■	2.2 x 11.7 x 8.3 7.5 5.7 x 7.6 Toshiba Intel Phoenix 1.20 ■ / ■ ■ / ■	1.8 x 12.4 x 8.3 7.1 5.2 x 6.8 ZDS Intel ZDS 3.9B ■ / ■ ■ / ■
2MB–10MB ❑ ❑	2MB–8MB ❑ 16K	2MB–8MB ■ ❑	2MB–6MB ■ ❑	4MB–6MB ■ ❑	2MB–10MB ■ ❑	2MB–10MB ■ 8K (internal)	2MB–8MB ■ 64K
1, 1, 1 ■	1, 1, 1 ■	1, 1, 1 ■	1, 1, 1 ■	1, 1, 1 ■	1, 1, 1 ■	1, 1, 1 ■	1, 1, 1 ❑
1 memory, 1 modem ❑ ❑ $999	1 memory, 1 modem ❑ ❑ $999	2 memory, 1 modem ■ ❑ $699	2 memory, 1 modem ■ ❑ $699	3 memory ■ ■ $999	1 memory, 1 modem 1 proprietary ■ ❑ $999	1 memory, 1 modem, 1 proprietary ■ ❑ $999	3 memory, 1 modem ■ ❑ ❑
NEC WD ❑	NEC WD ❑	Sharp Cirrus ❑	Sharp Cirrus ❑	Sharp WD ■	Toshiba WD ❑	Toshiba Paradise, WD ❑	Proprietary Proprietary ❑
78, 12, 4 ■ / ■	78, 12, 4 ■ / ■	80, 12, 4 ■ / ■	80, 12, 4 ■ / ■	79, 12, 4 ■ / ❑	82, 12, 8 ■ / ■ (with adapter)	82, 12, 8 ■ / ■ (with adapter)	82, 12, 4 ■ / ■
5.0 Microsoft Windows 3.0, *PFS: WindowWorks*	5.0 Microsoft Windows 3.0, *PFS: WindowWorks*	5.0, 4.01 DOS Shell, Microsoft Windows 3.0, *Qbasic*	5.0, 4.01 DOS Shell, Microsoft Windows 3.0, *Qbasic*	5.0 *BatteryPro*, Microsoft Windows 3.0	5.0 Microsoft Windows 3.0	5.0 Microsoft Windows 3.0	5.0 Microsoft Windows 3.0
Data-only ($335), data/fax ($585)	Data-only ($335), data/fax ($585)	Data/send-fax ($199), 9,600-bps MNP 5 data/fax ($399)	Data/send-fax ($199)	Data/send-fax ($299), 9,600-bps V.42bis data ($899)	External MNP 5 data ($459)	External MNP 5 data ($459)	MNP 5 data ($349), data/fax ($499)

CONTINUES

FACT FILE

Safari NSX/20 Notebook Computer
AT&T/Marubeni America Corp., 14-K Worlds Fair Dr., Somerset, NJ 08875; 908-302-5800.
List Price (tested configuration): $5,749.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 4.01, mouse, built-in data modem, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $479; 4MB RAM upgrade, $899; math coprocessor, $525; numeric keypad, $99; extra battery, $129; car battery adapter, $129; network adapter, $599; nylon carrying case, $99.

CIRCLE 482 ON READER SERVICE CARD

formance also gravitate toward the bottom of the pack, and its default video performance is slow. A fast-mode video setting buried in the poorly documented control-panel utility nearly doubled the Safari's video speed on PC Magazine Labs' video and Windows Graphics tests, but users may experience compatibility problems with certain applications.

The user manual lacks detail on the intelligent power-management features designed into the system and does not define specific settings that can be altered with the control panel, such as the video-performance enhancements. And although the unit's 9.5-inch width permits a spacious 82-key keyboard with dedicated cursor and position keys, the long travel distance and added pressure that are required to actuate a keystroke may bother some users.

AT&T covers its Safari NSX/20 Notebook Computer with a one-year mail-in warranty on parts and labor; a toll-free hotline is included for one year. Extended warranties are available, and you can get your Safari serviced through AT&T's dealer network.—*Nick Stam*

COMPAQ COMPUTER CORP.
Compaq LTE Lite/25

Compaq Computer Corp.'s brand-new notebook, the Compaq LTE Lite/25, represents the best combination of performance, portability, and price of the 14 systems in this review. This 6-pound 25-MHz 386SL-based system has a 16K four-way set-associative CPU cache and produced the best video performance and also the best CPU and memory performance of all the tested 386-based PCs.

The tested configuration included 4MB of RAM, an 80MB hard disk, DOS 5.0, and a nickel hydride battery; it costs $4,298—a passable price considering this is a Compaq PC. The company retained the 1.8- by 11- by 8.5-inch footprint of its old LTE line, yet found room for an inverted-T cursor-key layout instead of the goofy inverted-L layout of past LTEs. The screen is brighter and a bit bigger than the old LTEs. You can use built-in and external displays simultaneously; if you use the external monitor only, it can produce an 800-by-600 resolution.

The LTE Lite/25's battery life was average on PC Magazine Labs' Battery Rundown test: 2 hours 34 minutes. But this is a worst-case scenario; we were able to make it last 3 to 4 hours by enabling

PC LABS' BENCHMARK TESTS 6.0
Compaq LTE Lite/25

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	129	87	263	111
Memory	2,735	1,396	4,795	2,162
Disk (seeks/second)	155	130	244	157
Video	3,030	478	3,030	1,286
Windows Graphics	1,312	745	2,175	1,273

In Short: Compaq combines state-of-the-art performance and portability in a 6-pound system with a cached 386SL/25 CPU. It has the fastest video of all laptops tested, and only the Toshiba T4400SX beat the Compaq LTE Lite/25's overall performance. The keyboard finally has an inverted-T cursor-key layout, but the keys are stiff. This notebook has excellent security and power-conservation features. **Battery Life:** 2 hours 34 minutes.

SUMMARY OF FEATURES

Products listed in alphabetical order by company name

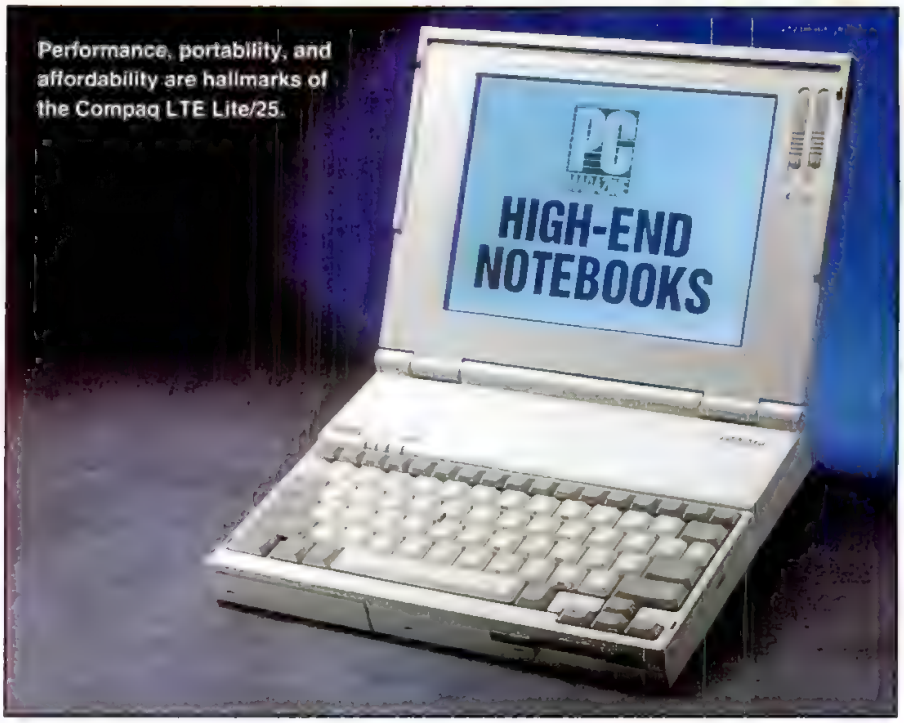
Editors' Choice ■—Yes ⊥—No

	AST Premium Exec 386SX/25	AT&T Safari NSX/20 Notebook Computer	Compaq LTE Lite/25	Everex Tempo Carrier 386SX/20	GRID 1755	Librex 386SX Notebook
AC ADAPTER AND BATTERY						
AC adapter voltage	115V/230V	100V/240V	120V/240V	110V/230V	120V/240V	110V/220V
AC adapter weight (pounds)	0.8	0.9	0.8	1.2	0.9	0.5
AC adapter size (inches)	1.5 x 2.5 x 5.5	1.8 x 2.8 x 5.3	1.4 x 3.3 x 5.3	1.8 x 2.6 x 5.9	1.8 x 2.5 x 5.3	1.3 x 2.3 x 3.5
Rated battery life (hours)	3	6	3–4.5	2	3	1.5
Tested battery life (hours:minutes)	4:06	4:06	2:34	1:46	2:28	1:20
Charge time with unit on, off (hours)	10–13, 3–5	6, 6	1.5–2, 1	1.5, 1.5	3, 1.5	8, 5
Battery weight (pounds)	1.2	1.6	1.3	0.7	0.8	0.8
Battery amp/hour rating	1.7Ah	1.4Ah	2.2Ah	2.4Ah	1.4Ah	5.0Ah
Power conservation in BIOS	■	■	■	■	■	■
Display/disk power-down	■/■	■/■	■/■	■/■	■/■	■/■
CPU/peripherals power-down	■/■	■/■	■/■	■/■	■/■	■/■
MISCELLANEOUS						
80387SX support	■	■	■	■	■	■
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
Cost of first-year on-site service	$45	N/A	N/A	N/A	N/A	N/A
FCC Class B identification number	DJKASTEXENBK	D78USA-65353-FA-E	CNT75MAFA	E3EEX-4302E	ACJ9TG25-3572	1QC-NSC-320SNT

N/A—Not applicable: The product does not have this feature.
C&T—Chips and Technologies Inc., WD—Western Digital.

Compaq's power-management features, which allow four levels of CPU speed, screen brightness and blanking, and drive activity. There is a standby mode that should get you through the business day on a single battery charge. Compaq's answer to Toshiba's week-long Auto-Resume mode is called *Hibernation*, which writes the contents of memory to disk and then suspends all activity indefinitely. Multilevel power management on SL systems is a mixed blessing. If you haven't typed anything for a minute or two, the system may seem to freeze for 5 or 10 seconds, but then a dozen or so keystrokes pop up on-screen.

Compaq offers virtually every form of security short of chaining the computer to your wrist: power-on password protection, a quick keyboard lock, hard-disk data locking (two levels), and physical locks for the system and the $929 expansion unit. The base-priced LTE Lite/25 includes 2MB of RAM internally and a 2MB slide-in memory card, which you can replace with a 4MB or 8MB card for a total of 6MB or 10MB. What do you do with the 2MB card you don't need? Compaq is hazy on whether your dealer will give you credit. For now, it's being handled individually. The BIOS is in flash memory, so updates can be handled without physically replacing a ROM chip. If you have never used a Compaq laptop, try the keyboard before you buy the machine. Key travel is short and extremely stiff.



Performance, portability, and affordability are hallmarks of the Compaq LTE Lite/25.

You can save $500 by buying the 60MB disk version of the LTE Lite/25. There is also a 20-MHz version, the LTE Lite/20, which has 40MB, 60MB, and 84MB hard disk options. The 60MB version costs $500 less than the 60MB Lite/25, while the 84MB version costs $600 less. With this model, however, you also get 2MB less RAM, a slower CPU, no CPU RAM cache, and a less-powerful nickel cadmium battery. Two options of interest to power users were slated to ship by the end

	NEC UltraLite III	NEC UltraLite SL/20	Philips Magnavox Metalis SX/20	Philips LX320	TI TravelMate 3000 WinSX	Toshiba T2200SX	Toshiba T4400SX	ZDS MastersPort 386SLe
	110V/220V	110V/230V	90V/240V	90V/240V	110V/230V	110V/240V	110V/240V	120V/125V, 200V/240V
	1.1	1.3	1.3	1.3	1.2	0.8	1.4	1.2
	1.4 x 3.6 x 6.4	1.4 x 3.6 x 6.4	1.8 x 3 x 7.5	1.8 x 2.9 x 7.4	2 x 3 x 5	1 x 2.8 x 5.5	1.9 x 3 x 6.3	2 x 3.5 x 6.5
	2	3–7	3–5	3–5	3–4	3.5	3.5	3
	1:45	2:21	3.28	2:25	2:23	3.19	4:19	2:53
	8.1	2.2	2.2	2.2	18.4–5	N/A.2	N/A.2	10.2
	0.7	0.7	1.4	1.2	1.2	1.5	2.3	1.4
	1.4Ah	1.7Ah	4.8V, 5.0Ah	14.4V, 1.7Ah	5.0Ah	14.4V, 2.2Ah	21V, 1.9Ah	14.4V, 1.7Ah
	■	■	■	■	■	■	■	■
	■ / ■	■ ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
	■ / ■	■ ■	■ / ■	■ ■	■ / ■	■ / ■	■ / ■	■ / ■
	■	■	■	■	■	■	■	■
	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
	Varies	Varies	N/A	N/A	$199	N/A	N/A	$93
	A3DPC47	A3DPC49	HFSQC338SX20	HFSSK2	A92S63T30	CJ6UN521	CJ6UK904	IFO-MSPORT-386SLE

ENDS

Safari NSX/20. Becau
Leave Your Office Wh

Ready to use out of the box

Battery life of up to 6 hours

DOS, Windows and AT&T Mail loaded

se You Can't Afford To en You're On The Road.

Safari Gives You Everything You Need For Mobile Networking. So You Don't Have To Leave Your Office When You're On The Road.

PC Computing MVP NOMINEE

Mobile Computing has become a way of life for people whose business takes them away from their office. But this has meant sacrificing connectivity for mobility, and portable PCs have fallen short of delivering the networking capabilities that business travelers need. Until now.

"[Its] performance and user-friendly hardware and software features make the Safari as close to perfection as you'll find today." *PC LapTop*, December 91

The Safari® NSX/20 Notebook Computer is the first notebook PC designed specifically for mobile networking, while still providing portability, ease of use, and the power of an Intel386® SX processor to run almost any application. With a LAN adapter or an integrated modem, the NSX/20 gives you superior connectivity worldwide. And it takes advantage of Mobile *Networked* Computing, a new level of mobile computing combining NCR's innovative portable technology with AT&T's worldwide connectivity, to let you network from anywhere in the world to anywhere in the world.

Enhanced Mobile Communications through optional LAN adapter or integrated modem

The Power of Portability

	Safari NSX/20	Compaq LTE 386/20	Toshiba T2000SX	ASI Premium EXTC 386SX-20	Dell 320N+
2400 Modem:	Standard	Optional	Optional	Optional	Optional
9600 FAX:	Standard w/60MB	N/A	N/A	N/A	Optional
Software Included:	DOS, Windows, AT&T Mail	None	DOS 4.01	DOS 3.3	None
Size:	8.5x11x1.6" 206 cu"	8.5x11x1.25" 215 cu"	8.3x11.7x1.6" 155 cu"	9x11.4x2.25" 231 cu"	8.5x11x1" 187 cu"
Drives:	40/80MB	30/60MB	40/60MB	20/40/60MB	60/80MB
Battery Life:	5 - 6 hrs.	3 hrs.	3+ hrs.	3 - 4 hrs.	4 - 5 hrs.
Screen Size:	10" Triple ST	9" Single ST	9.5" Single ST	8.5" Single ST	8.5" Single ST
Weight:	5.3 lbs.	7.5 lbs.	5.5 lbs.	7.3 lbs.	6.4 lbs.

The Safari NSX/20 Notebook Computer gives you superior power and portability in a competitively priced notebook PC.

The NSX/20 also comes loaded with DOS/Windows® and all the software you need for cellular modem connectivity, and other communications facilities. Including AT&T's advanced EasyLink® services, which give you access to a variety of options such as global messaging, AT&T Mail and FAX features, and on-line information services.

intel inside

Plus, the Safari NSX/20 Notebook Computer has superior VGA screen clarity, as well as a full-size keyboard with the look and feel you're used to in a PC. And it comes complete with a dual battery pack, which gives you up to 6 hours of uninterrupted power on the road.

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FACT FILE

EDITORS' CHOICE

Compaq LTE Lite/25
Compaq Computer Corp., 20555 Farm Hwy. 249, Houston, TX 77070; 800-231-0900, 713-370-0670
List Price (tested configuration): $4,298.
Tested Configuration: 4MB RAM, 84MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $299; 4MB RAM upgrade, $799; 8MB RAM upgrade, $1,499; math coprocessor, $279; external keyboard, $249; numeric keypad, $119; extra nickel cadmium battery, $129; extra nickel hydride battery, $199; extra AC power adapter, $149; car battery adapter, $99; 2,400-bps data modem, $319; 9,600-bps (MNP 5) data modem, $599; nylon carrying case, $139.

CIRCLE 483 ON READER SERVICE CARD

of March: a 120MB Conner hard disk ($500 more than the 80MB notebook) for the LTE Lite/25, and a 9,600-bps internal modem ($599) based on the low-power AT&T chip set. —*Bill Howard*

EVEREX SYSTEMS INC.

Everex Tempo Carrier 386SX/20

How small can you get and still include an internal 1.44MB floppy disk drive? Take a look at the 5.2-pound 1.8- by 8.5- by 11-inch Everex Tempo Carrier 386SX/20. Its performance is par for this group, but amenities include good battery life and power conservation, bundled Windows, a Logitech mouse, and a KeyMouse utility that gives mouse functions to designated keys.

Our $3,395 test configuration came with 4MB of RAM, an 80MB hard disk, and an internal 1.44MB floppy disk drive. You can upgrade the RAM from 2MB to 8MB in $299 2MB memory modules that are not user-installable. A 2,400/9,600-bps data/send-only fax modem added $329 to the price, bringing the total to $3,724. The matte-gray case, both strong and attractive, sets off a black keyboard with teal function/control key labels.

The Tempo's processor and memory scores were slightly below average. Video performance was below par, as well. Its disk performance, however, was slightly above average because of the Tempo's 17-millisecond IBM WDA-280 hard disk.

On PC Magazine Labs' Battery Run-down test, the Tempo's 0.72-pound nickel cadmium battery lasted 1 hour 46 minutes under full power. The battery, which takes about 1.5 hours to recharge even while it's supplying the unit with power, fits easily into a compartment on the bottom of the case, just beneath the Spacebar. An alarm and a blinking LED warn you about 3 to 5 minutes before it runs out.

POWER CONSERVATION

Power management, adjustable in system setup, includes screen and hard disk time-outs and a suspend/resume mode. The suspend mode switches off all power to the system except for the amount needed to maintain data in RAM. Smart Sleep, which Everex Systems claims can reduce power consumption by as much as 75 percent, slows the system clock to reduce battery drain.

VGA resolution on the Tempo Carrier's backlit 8.5-inch LCD screen is clean and crisp, without even a hint of streakiness. What's really annoying, however, is that the unit's 80-key keyboard has its four cursor keys arranged in a horizontal row instead of the now-standard inverted-T layout; the position keys require you to use the Fn key.

KeyMouse, a graphics pointing utility included in the test price, eliminates the need for a mouse or trackball. It works with Windows and lets you use the cursor keys to move a pointer on the screen; the F and D keys act as the primary and secondary click keys, respectively.

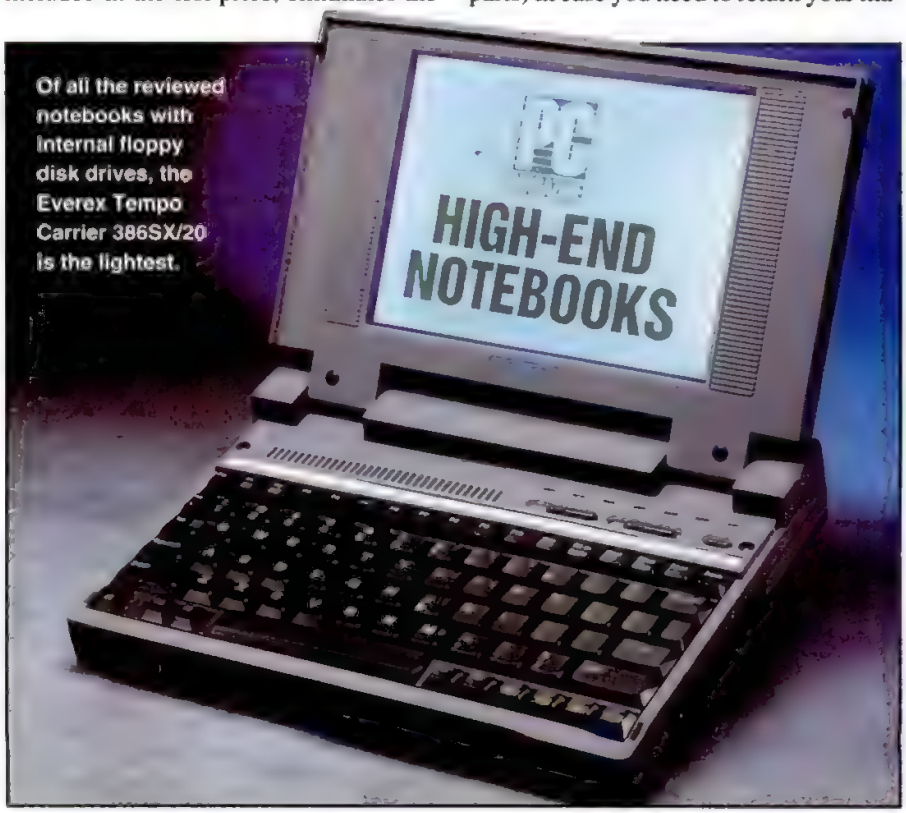
Everex offers a one-year warranty on parts and labor; an extended warranty is available. An Everex Tempo Carrier reseller is your first recourse in case of trouble, but the company pays for shipment both ways and promises a 48-hour turnaround (subject to the availability of parts) in case you need to return your ma-

PC LABS' BENCHMARK TESTS 6.0

Everex Tempo Carrier 386SX/20

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	89	87	263	111
Memory	1,588	1,396	4,795	2,162
Disk (seeks/second)	152	130	244	157
Video	846	478	3,030	1,286
Windows Graphics	968	745	2,175	1,273

In Short: Price and portability are two of the 5.2-pound Everex Tempo Carrier 386SX/20's best features. Even with its adapter, it weighs less than 6.5 pounds. The $3,395 price includes an 80MB hard disk. What's missing? An inverted-T cursor-key layout, for one thing. Although its disk performance was about average, its battery life and other test scores were slightly below the mark.
Battery Life: 1 hour 46 minutes.



Of all the reviewed notebooks with internal floppy disk drives, the Everex Tempo Carrier 386SX/20 is the lightest.

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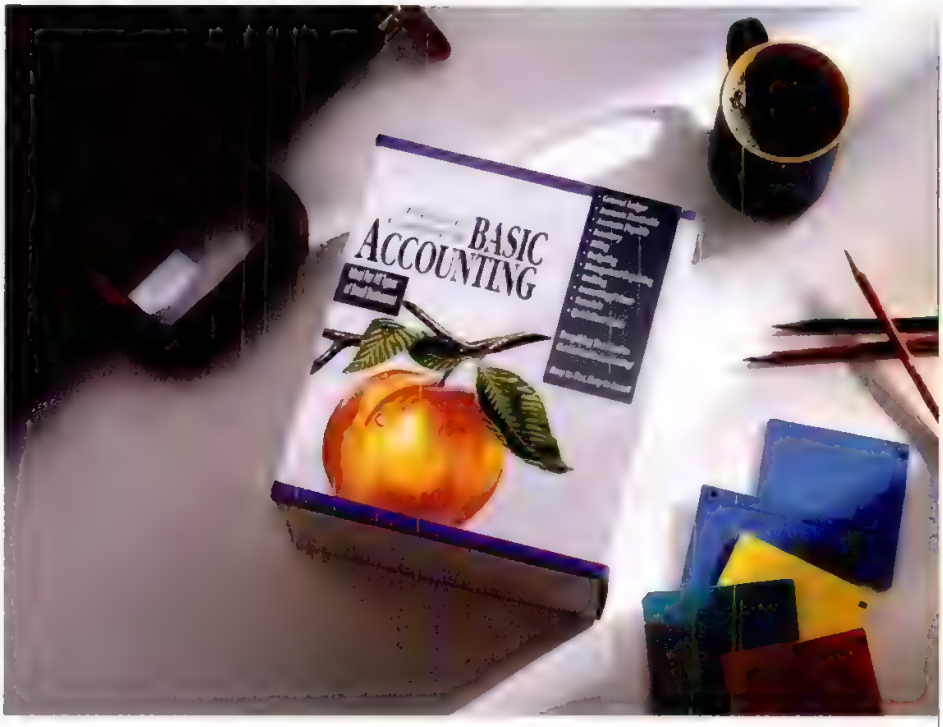

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CIRCLE 358 ON READER SERVICE CARD

FACT FILE

Everex Tempo Carrier 386SX/20
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; 800-992-3839, 510-498-1111.
List Price (tested configuration): $3,395.
Tested Configuration: 4MB RAM, 80MB IBM hard disk, 1.44MB floppy disk drive, DOS 5.0, mouse, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $299; math coprocessor, $169; external keyboard, $80; extra battery, $110; extra AC power adapter, $149; send/receive fax modem, $329.

CIRCLE 484 ON READER SERVICE CARD

chine. Technical support by phone or by fax is free, but the call is not toll free. —*Carolyn Falconer*

GRID SYSTEMS CORP.
GRiD 1755

The sleek GRiD 1755, a 386SX/20 notebook from GRiD Systems Corp., offers good power conservation and a great modem, though its attractive display is offset by slow video benchmark test scores.

Our $4,090 test unit came with an 80MB hard disk, weighed 6.4 pounds with its battery, and measured 1.7 by 12.2 by 10 inches. A send/receive fax modem also comes standard with this unit. You can install RAM through a panel on the unit's bottom, and there is an 80387SX coprocessor socket. The GRiD 1755 ships with 2MB of RAM, but our system had another 2MB added via a $395 upgrade card. A 6MB module that brings system RAM to its 8MB maximum costs $1,095. The GRiD 1755 comes with a CRT connector and one parallel, one serial, and one keyboard port.

FACT FILE

GRID 1755
GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94637; 510-656-4700.
List Price (tested configuration): $4,090.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, mouse, AC power adapter.
Options: 2MB RAM upgrade, $395; 6MB RAM upgrade, $1,095; math coprocessor, $169; external keyboard, $99.95; numeric keypad, $125; extra battery, $65; extra AC power adapter, $80; car battery adapter, $80; leather carrying case, $95.

CIRCLE 485 ON READER SERVICE CARD

The sidelit 8.75-inch triple-supertwist LCD screen was easy to read under many different lighting situations. It is preset to display 16 shades of gray, but you can change that number to 32 when in GRiD's "mode 13". A utility lets you specify a color map to make the screen more readable with certain applications. The cover opens about a third of the way down from the back of the unit, which lets you angle the screen for easier viewing when you're in cramped quarters, such as a train or a plane.

The GRiD 1755's 84 keys include 12 function keys, an inverted-T cursor-key layout and dedicated position keys, and extra-large Enter, Backspace, and Shift keys. The Fn key gives many of the 12 function keys a dual purpose, letting you use the keyboard to reduce the processor speed; shut down the hard disk, video, or I/O ports; or enter standby mode. The keys themselves had a springy, less tactile feel and were quiet when touched.

TWO POWER MODES

Power management consists of two modes that you can configure during setup: The standby mode reduces current to the hard disk and video without actually powering down. The suspend mode actually turns the unit off but takes you right back to your application when you start the unit up again.

The GRiD 1755's 0.8-pound nickel cadmium battery lasted 2 hours 28 minutes at full power on PC Magazine Labs' Battery Rundown test—better than many other systems in this roundup. Its processor, memory, and disk test scores were about average, but the GRiD 1755's video score was well off the mark

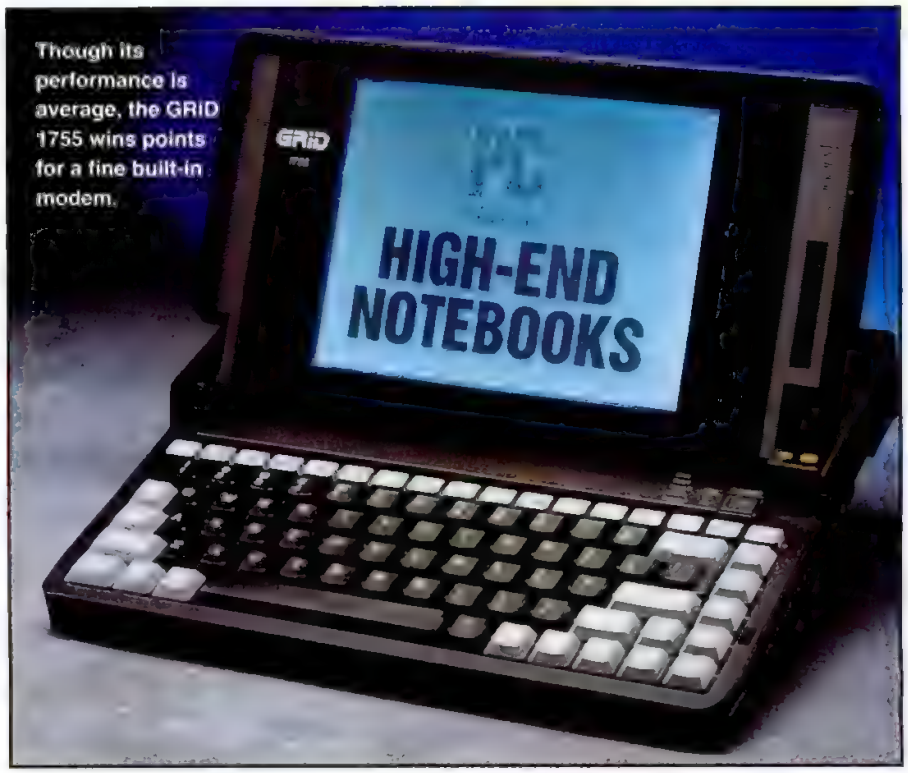
GRiD offers a standard one-year warranty on parts and labor and toll-free technical support.—*Margaret A. Piemonte*

PC LABS' BENCHMARK TESTS 60

GRiD 1755

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	93	87	263	111
Memory	1,834	1,396	4,795	2,162
Disk (seeks/second)	151	130	244	157
Video	691	478	3,030	1,286
Windows Graphics	964	745	2,175	1,273

In Short: We give the $4,090 GRiD 1755 mixed marks: An almost 2.5-hour battery life may seem like the average for this group, but this battery is among the most efficient. The GRiD 1755 also comes with a great modem: V.42bis error correction and data correction enhance its 2,400-bps data and 9,600-bps fax capabilities. Middling performance scores are its only drawback.
Battery Life: 2 hours 28 minutes.



Though its performance is average, the GRiD 1755 wins points for a fine built-in modem.

In Response To Our Highest Ratings, We Present Our Lowest Prices.

TEMPO

Ever since its introduction, the Tempo™ LX 386SX/20 from Everex™ has earned a steady stream of accolades from critics and users alike. *Portable Office* magazine even proclaimed, "...This one deserves the award for the best notebook PC yet."†

But it was probably the editors of *PC/Computing* who said it best "The Tempo LX has everything it takes to make notebook computing a productive experience: a great keyboard; a large, bright (VGA backlit) display; long battery-charge life; effective power management features and amazing durability. It's hard to beat its unique combination of great features. All things considered, the Tempo LX is the best value around."††

Not surprisingly, it also won *PC/Computing's MVP Award* for best PC-compatible notebook.

PC Computing MVP MOST VALUABLE PRODUCT WINNER

You might think all this praise would make it difficult to get your hands on a Tempo LX. Which is exactly why we've made it a whole lot easier—by reducing the price.

intel inside

The 60MB Tempo LX is now only $2,349.

Best of all, you'll get the popular features highlighted by *PC/Computing*, plus 1MB of RAM (upgradeable to 5MB), a 1.44MB internal floppy drive, a full 82-key keyboard and a powerful one-hour quick-charge capability. All in a package weighing in at about seven pounds.†††

We'll even throw in a Microsoft®-compatible mouse, Microsoft Windows™ 3.0 and MS-DOS® 5.0, a durable carrying case and a one-year parts & service warranty (including free overnight pick-up and delivery within the continental U.S.)—that's a $423 value at no extra charge!

So if you're looking for a notebook PC offering high performance and even higher ratings, call today for the location of the Everex reseller nearest you.

Because at this price, there's never been a better time to pick up the Tempo.

FOR ADDITIONAL INFORMATION
or the reseller near you call:
1-800-437-EVER.
In Canada (1-800-663-5161)
Outside North America (510-498-1111).

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†Portable Office, May 1991 ††PC/Computing November 1991 †††Weight, which includes battery, varies with hard disk size. Suggested retail prices subject to change without notice. GSA schedule #GS00K91AGS5073. *© 1992 Everex Systems, Inc. All rights reserved. EVER for EXcellence is a registered trademark, and Everex and Tempo are trademarks of Everex Systems, Inc. The Intel Inside logo is a trademark of Intel Corporation. Other company and product names are the registered trademarks of their respective holders.*

BENCHMARK TESTS

The 486SX-based Toshiba T4400SX outperformed all the 386-family notebooks on the processor and memory benchmark tests. The Compaq LTE Lite/25 and ZDS MastersPort 386Le, with their cached 386SL/25 CPUs, turned in processor scores about 45 percent better than the Toshiba T2200SX, a 386SX/20. The AST Premium Exec 386SX/25's CPU also outperformed that of the Toshiba T2200SX.

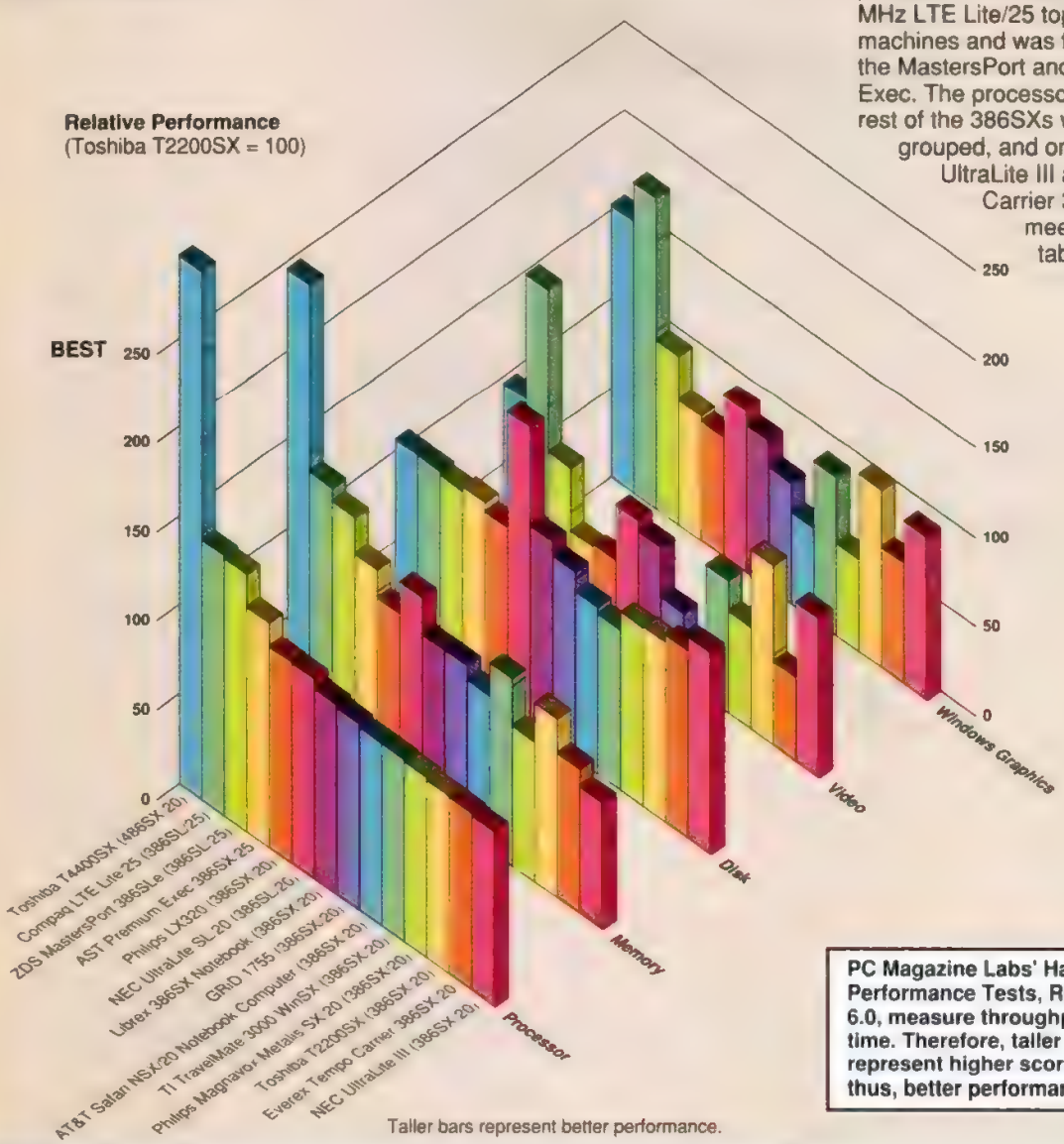
WHAT THE NUMBERS MEAN

The 14 notebook PCs in this review were the first to be evaluated using PC Magazine Labs' Hardware Performance Tests, Release 6.0. These new processor, memory, disk, and video tests measure throughput or the number of operations completed in a fixed period of time; therefore, a higher score means better performance. To evaluate each PC's EGA or VGA performance more thoroughly, we have added a graphics component to the DOS video test.

A fifth metric—the graphics portion of PC Magazine Labs' Windows benchmark tests—measures video performance while running frequently used graphics raster operations under Windows 3.0.

This roundup included several processor types, including one 486SX/25 (the Toshiba T4400SX), two 386SL/25s (the Compaq LTE Lite/25 and ZDS MastersPort 386SLe), and one 386SL/20 (the NEC UltraLite SL/20). The AST Premium Exec 386SX/25 came with Advanced Micro Devices' 25-MHz Am386SXL processor. The remaining nine used the 20-MHz Intel 386SX chip.

As expected, the 486SX-based Toshiba T4400SX outran all of the 386SX and 386SL machines on the processor and memory tests. The 25-MHz LTE Lite/25 topped the remaining machines and was followed closely by the MastersPort and the Premium Exec. The processor scores for the rest of the 386SXs were closely grouped, and only the NEC UltraLite III and Everex Tempo Carrier 386SX/20 failed to meet the standard established by our



Taller bars represent better performance.

PC Magazine Labs' Hardware Performance Tests, Release 6.0, measure throughput, not time. Therefore, taller bars represent higher scores, and thus, better performance.

Toshiba T2200SX reference system.

Eleven notebooks relied on a 19-millisecond Conner CP-2064 or Conner CP-2084 hard disk, and they had disk scores that ranged from roughly 164 KBps (the Librex 386SX Notebook) to 130 kilobytes per second (the TI TravelMate 3000 WinSX). Our standard-bearer, the Toshiba T2200SX, logged in at 146 KBps. The 16-ms. Quantum Go■Drive used by the UltraLite SL/20 ran away with disk performance honors at 244 KBps—nearly 70 percent better than the Toshiba T2200SX's score.

The LTE Lite/25 was by far the best on our DOS video test and also topped the Windows Graphics index, though by a lesser margin over the second-place Toshiba T4400SX. Six machines that used Western Digital video chip sets scored above average on the DOS and Windows video tests, while the five using Cirrus Logic chip implementations performed below average. Cirrus provides a utility program that allows improved video access to CPU memory, presumably leading to faster video performance. Trial tests by PC Labs confirmed this improvement, but the option may not be well suited for all applications, according to the manufacturer. For that reason, we did not invoke the option during our evaluation, and we report the standard results. The MastersPort, with its proprietary video, was a little better than average, and the Chips and Technologies video implementation included with the Tempo was a little worse than average.

For the most part, systems that performed well on our DOS-based video test also did well on our Windows benchmark test. The Toshiba T4400SX was the runner-up on the Windows Graphics test, and the Toshiba T2200SX took that position on the DOS video test. The LTE Lite/25 was the leader in both categories, and AT&T's Safari NSX/20 Notebook Computer turned in the lowest scores on both.

HOW WE TESTED

PC Magazine Labs' Hardware Performance Tests, Release 6.0, measure the PC's processor, memory, disk, and video subsystem performance. Each test measures the number of operations performed or the data throughput over a period of time. We mathematically reduce the raw scores to yield an appropriate mean. The three-dimensional bar charts show the relative performance of the tested machines, with the Toshiba T2200SX scores set at 100. In all cases, a larger number means better performance.

We performed all the tests with the RAM and video cache shadowing enabled whenever possible. We report the disk performance without software disk caches.

■ The **Processor** test measures different aspects of the CPU's performance and its interaction with cache and main memory. The test consists of eight routines: an Instruction Mix native to the microprocessor type (386 or 486, for instance), 128K No-Operation, Do-Nothing, Integer-Add, Integer-Multiply, Floating-Point Mix, String-Sort and -Move, and Prime-Number Sieve routines. We report the results in processor operations per second.

■ The **Memory** benchmark test measures the read/write performance of the computer's first 640K of conventional memory. We report the results in kilobytes per second.

■ The **Disk** benchmark test evaluates the mechanical drive speed, hard disk controller functions, and bus speed, using a series of small-record (512-byte and 4K) exercises followed by similar large-record (16K and 32K) exercises. Both small- and large-record exercises include file-create, sequential write/read, and random write/read operations. We report the results in kilobytes per second.

■ The **Video** benchmark test consists of text and graphics routines. In the Direct Screen Write routine, the video adapter's screen memory writes text to the screen. The test then performs several graphics operations, including screen fills and bit-block transfers (BitBlts). We report the results in thousands of video operations per second.

■ PC Magazine Labs' **Windows Graphics** test measures the video subsystem's performance under Microsoft Windows 3.0. We use manufacturer-provided video drivers to test systems at VGA resolution (640 by 480 pixels). These tests perform a set of raster operations frequently run under Windows, such as drawing lines and rectangles and inverting on-screen patterns. We report the results in kilopixels per second.

	Processor (operations per second)	**Memory** (kilobytes per second)	**Disk** (kilobytes per second)	**Video** (thousands of operations per second)	**Windows Graphics** (kilopixels per second)
Toshiba T4400SX (486SX/25)	262.77	4,794.94	155.82	1,758.45	2,175.00
Compaq LTE Lite/25 (386SL/25)	129.04	2,735.41	155.02	3,030.36	2,478.35
ZDS MastersPort 386SLe (386SL/25)	127.48	2,593.70	152.33	1,356.60	1,345.00
AST Premium Exec 386SX/25	111.08	2,188.25	156.07	720.93	988.56
Philips LX320 (386SX/20)	99.49	1,885.27	149.14	749.82	948.93
NEC UltraLite SL/20 (386SL/20)	98.92	2,236.13	243.80	1,323.21	1,290.28
Librex 386SX Notebook (386SX/20)	94.43	1,834.02	163.79	1,211.90	1,182.37
GRiD 1755 (386SX/20)	92.86	1,834.02	151.49	691.19	964.23
AT&T Safari NSX/20 Notebook Computer (386SX/20)	91.03	1,677.07	135.19	477.87	744.73
TI TravelMate 3000 WinSX (386SX/20)	90.94	2,032.76	129.72	1,353.68	1,259.43
Philips Magnavox Metalis SX/20 (386SX/20)	90.13	1,528.35	144.42	1,035.94	744.73
Toshiba T2200SX (386SX/20)	88.65	1,948.96	145.61	1,826.64	1,420.47
Everex Tempo Carrier 386SX/20	88.57	1,587.59	151.82	845.80	967.67
NEC UltraLite III (386SX/20)	87.32	1,395.91	163.14	1,620.60	1,311.67

Higher scores represent better performance.

LIBREX COMPUTER SYSTEMS INC.

Librex 386SX Notebook

Better not drift too far from shore—or from an electrical outlet—when using the Librex 386SX Notebook. Though its light weight and good performance will tempt you to take it anywhere, you will have to carry a spare battery wherever you go.

One of the lightest systems with an internal 1.44MB floppy disk drive, the Librex measures 2 by 11.5 by 8.4 inches and weighs 6.3 pounds. The $3,299 unit we tested had a 40MB hard disk, but a 60MB version is available for $3,599. An optional $429 send/receive fax modem brings the 60MB unit's price to $4,028, though you can get a data-only modem for $80 less.

The system has some well-planned design features, such as rounded edges and recessed controls. A front-mounted spring latch guards against opening the system inadvertently. To prevent accidental shutdown, you must press the notebook's power button for about 3 seconds. Connectors for external equipment are neatly recessed: The RJ-11 phone jack is on the unit's left; one parallel port, two serial ports, and a connector for an external CRT display lie behind a hinged panel on the back. Unfortunately, expandability is not one of the Librex's better features; it holds only 4MB of RAM.

The unit's 9.5-inch backlit VGA LCD can display 16 shades of gray and allows reverse video; contrast and brightness controls are recessed on the right side of the screen. Combining the Fn key with such keys as Home, End, PgUp, and PgDn gives the 82-key keyboard 101-key functionality. All keys except the function keys are full-size.

PC LABS BENCHMARK TESTS

Librex 386SX Notebook

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	94	87	263	111
Memory	1,834	1,396	4,795	2,162
Disk (seeks/second)	164	130	244	157
Video	1,212	478	3,030	1,286
Windows Graphics	1,182	745	2,175	1,273

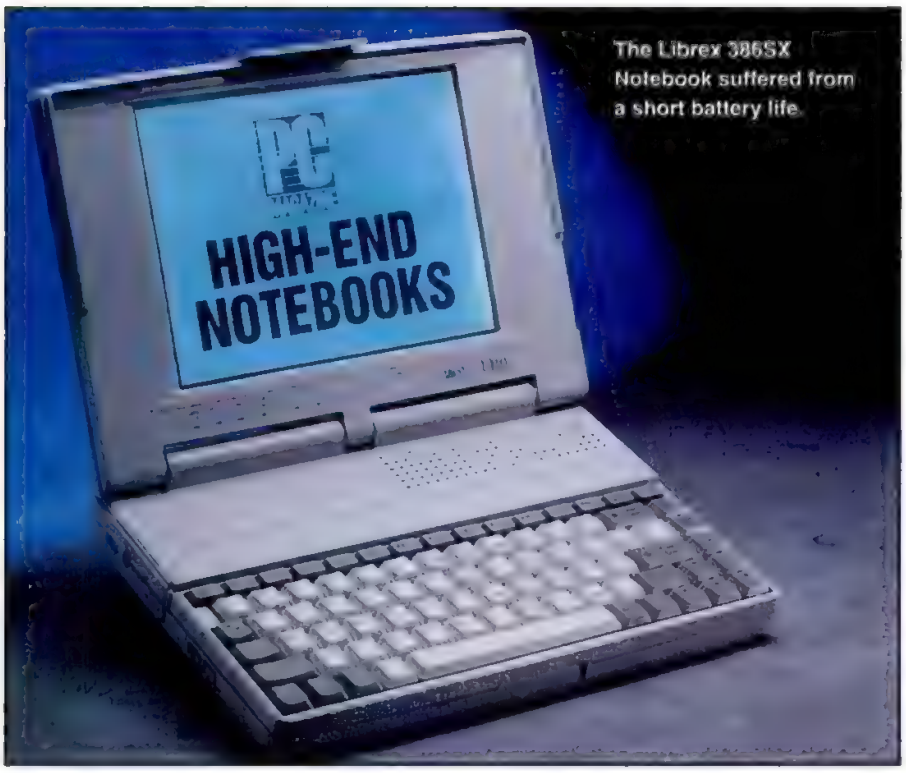
In Short: Carry a spare battery when you use your Librex in the field. Due to the PC's low weight and small size, its battery had the shortest life of the group. The $3,299 price would be more impressive if the Librex had a 60MB or 80MB hard disk, but it still placed second on our disk test. This 6.3-pound 386SX/20 notebook is ergonomically designed, and its other scores were good for this class.
Battery Life: 1 hour 20 minutes.

The benchmark test results for this system were about average or slightly better. Its processor and memory performance were on a par with that of other 20-MHz noncached systems we tested; the Western Digital video chip set scored above average on the 16-bit screen-write video benchmark test and compared favorably with other systems in terms of our Windows Graphics test. The Conner hard disk placed second among all contenders.

Battery life and weight go hand-in-hand. Therefore, this 0.7-pound nickel cadmium battery, one of the lightest of our test group, lasted 1 hour 20 minutes under full power on PC Magazine Labs' Battery Rundown test. An AC adapter, also one of the smallest and lightest of the tested machines, fully recharges the battery in 5 hours with the power off. But you may prefer either using a quick charger ($159) for 1-hour rejuvenation or running the Librex on an automobile adapter ($99). Another option is the spare battery, which costs $59.

Power-conservation parameters, adjustable during system setup, shut down all hard disk, floppy disk drive, I/O, and video activity after specified intervals. You can also halve the system's normal 20-MHz speed either in BIOS setup or with a hotkey combination; a complementary hotkey combination switches you back. A suspend/resume mode shuts down the processor, retains RAM contents, and maintains operating-system status when you close the cover. When you open the cover, operation resumes where you left off.

The Librex 386SX Notebook is covered by a one-year warranty. Librex Computer Systems sells through dealers and maintains a toll-free service support number.—*Alan M. Stoughton*

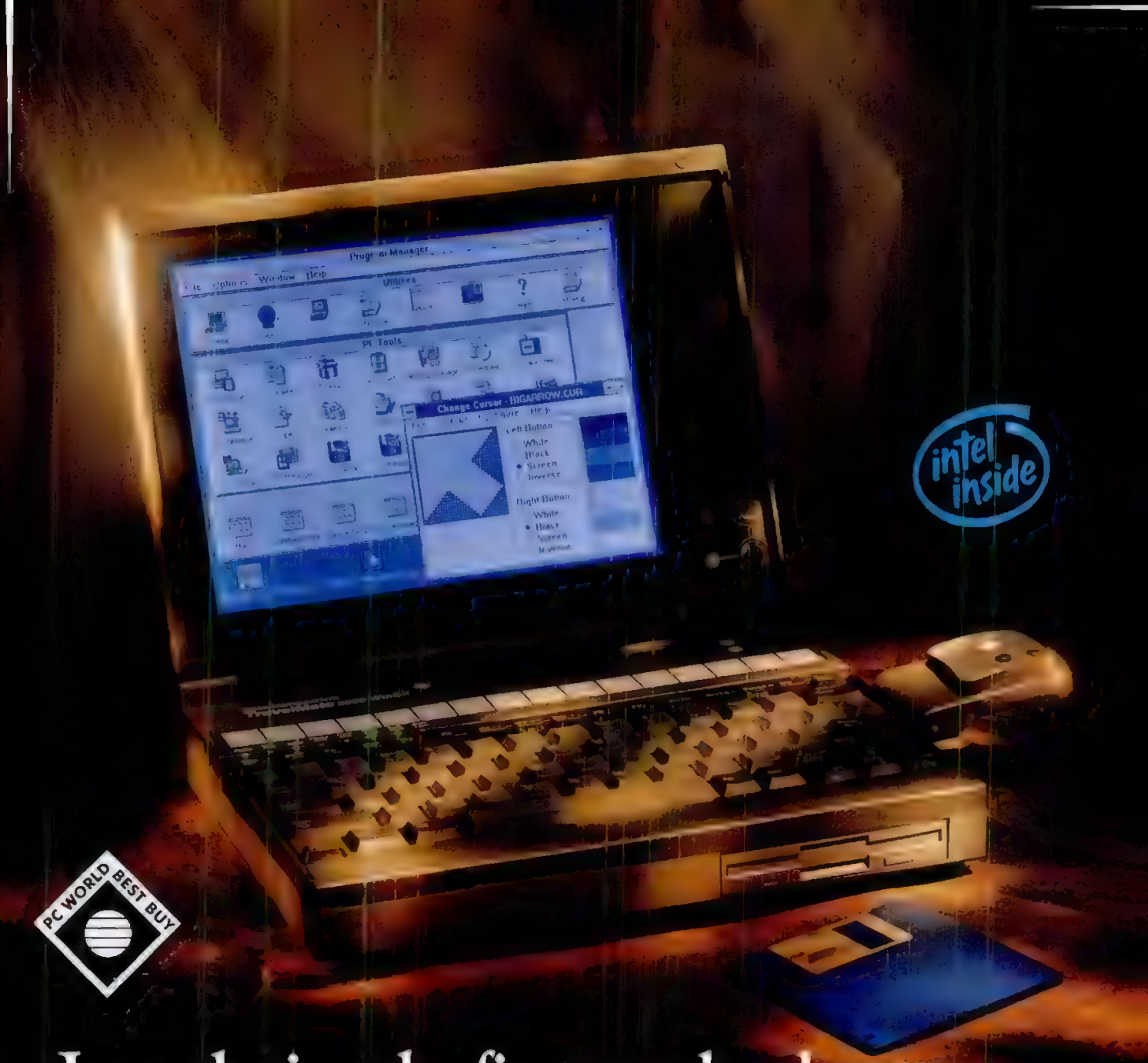


The Librex 386SX Notebook suffered from a short battery life.

FACT FILE

Librex 386SX Notebook
Librex Computer Systems Inc., 1731 Technology Dr., #700, San Jose, CA 95110. 408-441-8500
List Price (tested configuration): $3,299
Tested Configuration: 4MB RAM, 40MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case
Options: Upgrade to 60MB hard disk, $300; math coprocessor, $240; extra battery, $59; extra AC power adapter, $59; worldwide power adapter, $99; car battery adapter, $99; 2,400-bps data modem, $249; send/receive fax modem, $429; leather carrying case, $229.

CIRCLE 486 ON READER SERVICE CARD



Introducing the first notebook computer designed to make Windows™ a breeze.

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CIRCLE 304 ON READER SERVICE CARD

BATTERY LIFE VS. PORTABILITY

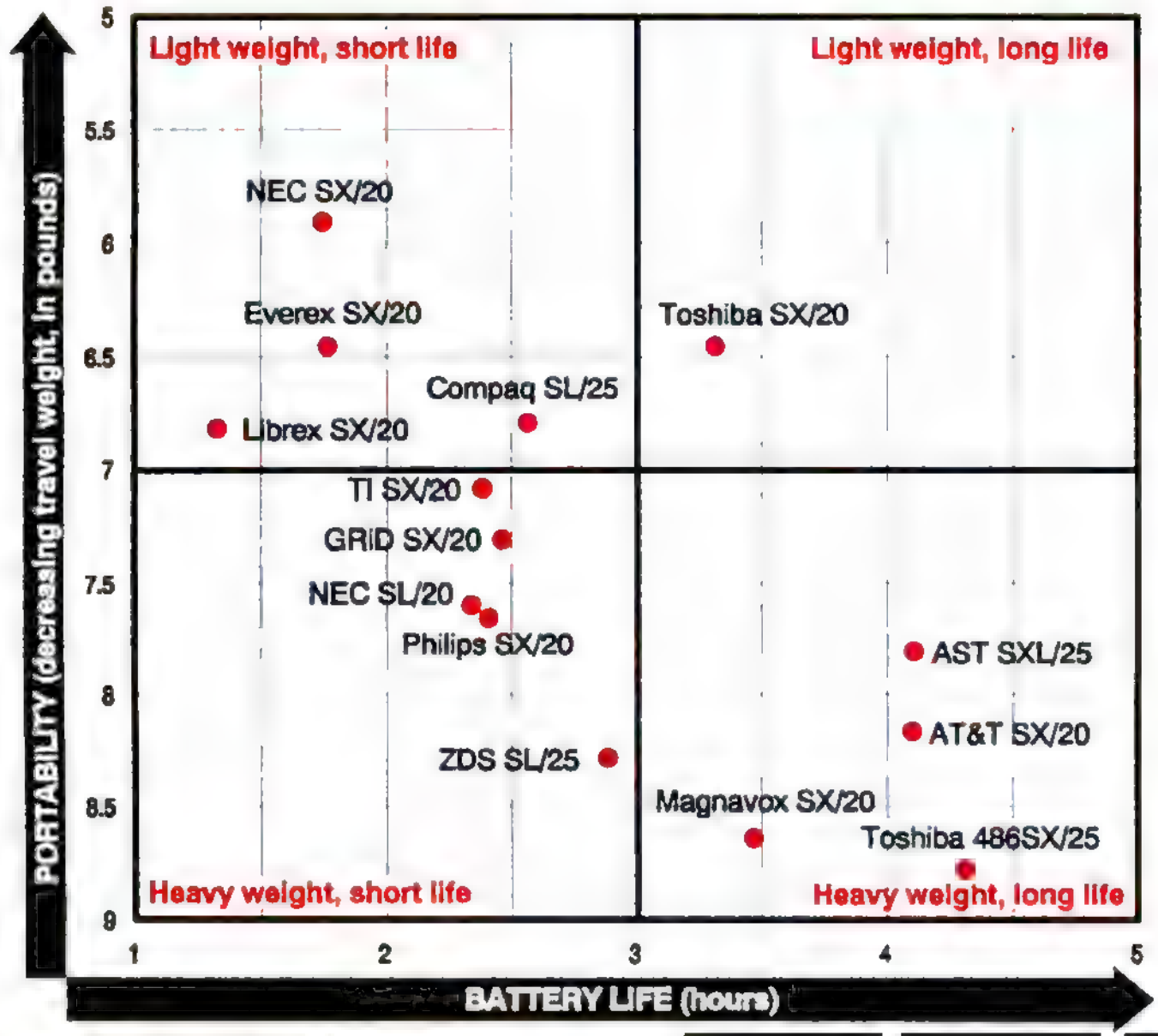
The 486SX-based Toshiba T4400SX had both the longest battery life (4 hours 19 minutes) and—no surprise—the heaviest battery (2.3 pounds). The AST Premium Exec 386SX/25 and AT&T's Safari NSX/20 Notebook Computer tied for second place on battery life: 4 hours 6 minutes. The Premium Exec's 1.2-pound battery, however, powered a 25-MHz CPU; the Safari's 1.6-pound battery ran a 20-MHz CPU.

On battery life per pound, the NEC UltraLite SL/20 came in second and the GRiD 1755 third. The GRiD 1755's efficiency is due to proprietary, power-saving BIOS revisions of the Phoenix firmware. At 0.8 pounds, its battery was one of the lightest of the group.

Four systems—the AST Premium Exec 386SX/25, Compaq LTE Lite/25, NEC UltraLite SL/20, and ZDS MastersPort 386SLe—used chips optimized for low power consumption. The battery life for the MastersPort and UltraLite SL/20 was well behind the AMD-based Premium Exec and other leaders.

Although the MastersPort ranked sixth on battery life (2 hours 53 minutes), it outperformed the AST, Compaq, and NEC units on our processor, memory, and video benchmark tests. At 2 hours 34 minutes, the LTE Lite/25 placed seventh on battery life; the UltraLite SL/20 was eleventh, at 2 hours 21 minutes. To its credit, the UltraLite SL/20 came with one of the very lightest batteries; like the Premium Exec, it had an excellent battery life per pound.

Both the Magnavox Metalis SX/20 and the Toshiba T2200SX came close to the 3.5-hour mark; six others fell between 2 and 3 hours. The Everex Tempo Carrier 386SX/20, NEC UltraLite III, and Librex 386SX Notebook had battery lives of less than 2 hours. Only the LTE Lite/25 and Toshiba T2200SX had nickel hydride batteries; all the others used nickel cadmium units.

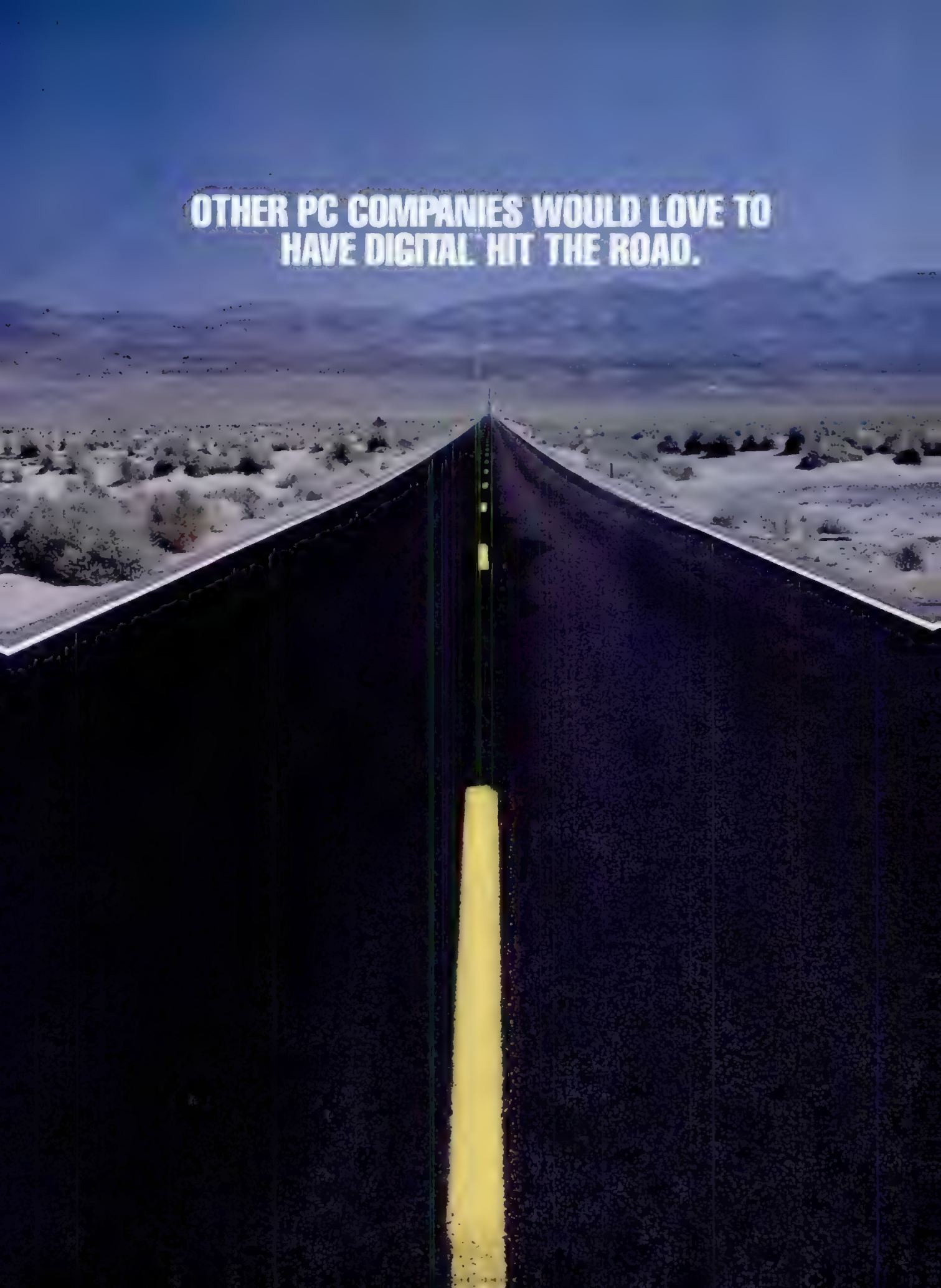


Good battery life often means carrying a heavier system. We charted these 14 notebooks on two important criteria: total travel weight (PC, battery, and charger) and battery life. If your top priority is portability, the 6.5-pound Toshiba T2200SX is your best bet. If it's extra-long battery life, choose the Toshiba T4400 SX, the AST Premium Exec 386SX/25, or AT&T's Safari NSX/20 Notebook Computer.

BATTERY LIFE AND HOURS PER BATTERY POUND

	Processor	Battery Rundown time (hours: minutes)	Rank	Battery weight (pounds)	Rank	Battery life per pound (hours: minutes)	Rank	System weight (pounds)	Rank	Travel weight with adapter (pounds)	Rank
Toshiba T4400SX	486SX/25	4:19	1)	2.3)	14)	1:51	11)	7.4)	13)	8.8)	14)
AST Premium Exec 386SX/25	Am386SXL/25	4.06	2)	1.2)	6)	3:22	1)	7.0)	10)	7.8)	10)
AT&T Safari NSX/20 Notebook Computer	386SX/20	4:06	2)	1.6)	13)	2:37	4)	7.3)	12)	8.2)	11)
Philips Magnavox Metalis SX/20	386SX/20	3:28	4)	1.4)	10)	1:30	13)	7.4)	13)	8.6)	13)
Toshiba T2200SX	386SX/20	3:19	5)	1.5)	12)	1:17	14)	5.6)	3)	6.5)	2)
ZDS MastersPort 386SLe	386SL/25	2:53	6)	1.4)	10)	2:07	7)	7.1)	11)	8.3)	12)
Compaq LTE Lite/25	386SL/25	2:34	7)	1.3)	9)	1:58	9)	6.0)	5)	6.8)	4)
GRiD 1755	386SX/20	2:28	8)	0.8)	4)	3:05	3)	6.4)	8)	7.3)	7)
Philips LX320	386SX/20	2:25	9)	1.2)	6)	2:03	8)	6.4)	8)	7.7)	9)
TI TravelMate 3000 WinSX	386SX/20	2:23	10)	1.2)	6)	1:56	10)	5.9)	4)	7.1)	6)
NEC UltraLite SL/20	386SL/20	2:21	11)	0.7)	1)	3:15	2)	6.3)	6)	7.6)	8)
Everex Tempo Carrier 386SX/20	386SX/20	1:46	12)	0.7)	1)	2:27	5)	5.2)	2)	6.5)	2)
NEC UltraLite III	386SX/20	1:45	13)	0.7)	1)	2:24	6)	4.8)	1)	5.9)	1)
Librex 386SX Notebook	386SX/20	1:20	14)	0.8)	4)	1:42	12)	6.3)	6)	6.8)	4)

Rundown time and battery life per pound are ranked from longest to shortest. Battery, system, and travel weights are ranked from lightest to heaviest.


OTHER PC COMPANIES WOULD LOVE TO
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HERE WE GO!

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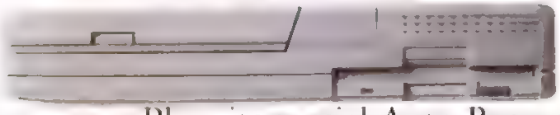

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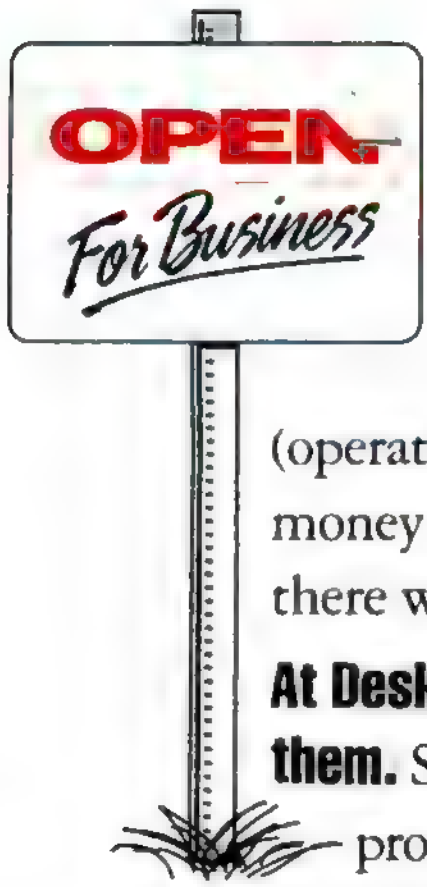

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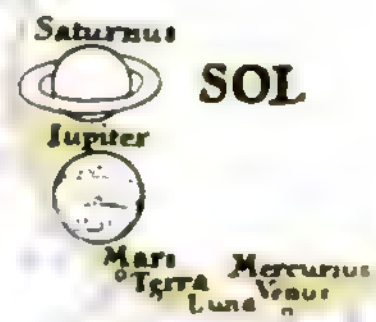

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Includes:

Microprocessor:	Intel i386sx running at 20MHz
Memory:	2MB
Storage:	80MB IDE Hard Disk Drive 3.5" 1.44MB Floppy
Display:	TST Backlit VGA
Modem:	2400 bps Data
Keyboard:	84-key
Mouse:	Logitech™ TrackMan® Portable
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0 (factory installed)

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DESKTOP DIRECT 48 TURNAROUND

The **DEC**station™ 320sx

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Memory:	1MB, 80ns Memory Kit
Storage:	52MB IDE Hard Disk Drive
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Keyboard:	101-key
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DESKTOP DIRECT 48 TURNAROUND

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Includes:

Microprocessor:	Intel i486sx running at 33MHz
Memory:	8MB, 70ns Memory Kit
Storage:	40MB IDE Hard Disk Drive 3.5" 1.44MB Floppy
Resolution Mode:	1280 X 1024 TIGA Adapter
Display:	20" Color Monitor
Keyboard:	101-key
Mouse:	Three-button
Operating Systems:	MS-DOS 5.0 and MS-Windows 3.0

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- ☐ DECpc i386 and i386sx based systems
- ☐ DECpc i486 and i486sx based systems
- ☐ The DECpc 320P Notebook
- ☐ The Catalog

Customization Worksheet

Your base system is a: ☐ 286 ☐ 386 ☐ 486 ☐ Other

How many applications will your PC(s) run in a typical workday? _____

What best describes the type of work the system will be used for? (Check all that apply)

☐ Word Processing	☐ Desktop Publishing	☐ Scientific Research
☐ Order-entry	☐ Education	☐ Software Development
☐ Database (filing records)	☐ Design (CAD/CAM)	☐ E-Mail
☐ Financial Calculations	☐ Engineering	☐ Other industry-specific applications (please specify)
☐ Retail Store Management	☐ Industrial Process Control	

How many people work in your group, department or small business?
☐ Less than 10 ☐ 10-20 ☐ 20-35 ☐ More

Is your operating system:
☐ DOS ☐ DOS with Windows ☐ OS/2 ☐ MAC ☐ UNIX™ ☐ Other

Which of the following graphics-oriented applications best describes your needs? (Check all that apply)

☐ Desktop Publishing	☐ Realtime Modeling	☐ AutoCad
☐ CAD/CAM	☐ Animation	☐ Business Graphics
	☐ Image Processing	

LAN Communication

How many PCs do you have installed? _____ From how many manufacturers? _____

What kinds of connections does your PC(s) require? (Check all that apply)

- ☐ Links with other PCs in the immediate surroundings
- ☐ Connection to the local area network (LAN) throughout a building
- ☐ A line to a host system in a remote location

What kind of media (cable) is used in your LANs today? _____

What is the networking software now being used in your company? _____

What kind of host system will your PC communicate with?
☐ DECpc ☐ IBM ☐ Other _____

What Kind of Service Do You Really Need?

☐ On-site Hardware Support ☐ Software Support ☐ Telephone Support
☐ Training ☐ FAX Hotline

How many of your users take portables on the road? _____

Do you currently have a service contract(s) for your PCs? How many? _____

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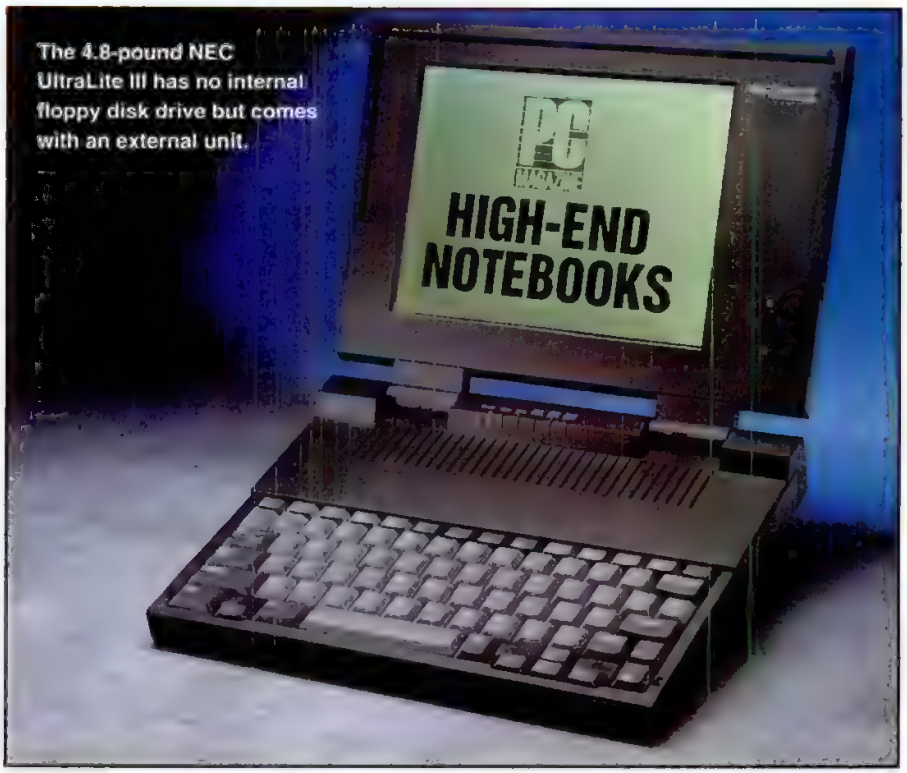
NEC TECHNOLOGIES INC.
NEC UltraLite III

The sleek and stylish NEC UltraLite III packs a 60MB hard disk into a 1.5- by 11.5- by 9-inch case and weighs a mere 4.8 pounds. But watch out for those extras! An external 1.44MB floppy disk drive and AC adapter bring the carrying weight to 7.1 pounds—still fairly light but no longer spectacular.

The $3,298 UltraLite III has a 386SX/20 processor but leaves no room for an internal 1.44MB floppy disk drive. (An external unit is included in the price.) All memory and modem installations must be done by NEC Technologies. An internal 2,400/9,600-bps modem with send/receive fax capabilities and MNP 5 data compression costs $585. Therefore, a system with 4MB RAM and a send/receive fax modem would cost $3,883.

The UltraLite III's 16-bit Western Digital video chip set performed well on the graphics portion of the Windows Graphics benchmark test using the standard Windows driver. NEC runs the UltraLite III's video bus at 10 MHz, making this notebook's video faster than that of its sibling, the NEC UltraLite SL/20. Its processor and memory test scores were unremarkable, although the 19-millisecond 60MB Conner hard disk, with its 32K cache, put the UltraLite III's disk score among the top three in this review. (A 60MB unit is the largest disk available for this model.)

Battery-conservation features include automatic video and hard disk power-down, standby/resume, and idle modes.



The 4.8-pound NEC UltraLite III has no internal floppy disk drive but comes with an external unit.

Idle mode slows the CPU down to 4 MHz after a second of inactivity. Standby mode, activated by pressing a button or through setup, shuts down all possible devices, retaining only the RAM contents and the system status. It works particularly well with the optional internal modem: The unit waits for a call in standby mode, then wakes up when it comes in. The 0.7-pound nickel cadmium battery lasted 1 hour 45 minutes on PC Magazine Labs' Battery Rundown test. The recharge time is 1 hour with the power off and 8 hours with the power on.

The UltraLite III has a 9.75-inch triple-supertwist nematic (TSTN) screen; cold-cathode fluorescent tube (CCFT) side-lighting makes it easy to read and bright enough to be seen in low light. The 78-key keyboard feels sluggish but has 12 function keys, an inverted-T cursor-key layout, and standard 0.75-inch spacing.

The company's mail-in policy covers the NEC UltraLite III for one year on parts and labor, but you pay shipping charges both ways. You can extend this warranty for a second year. On-site service is available through third-party companies.
—*Mario Baldasserini*

FACT FILE

NEC UltraLite III
NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 508-264-8000
List Price (tested configuration): $3,298.
Tested Configuration: 2MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, mouse, AC power adapter, carrying case
Options: 2MB RAM upgrade, $299; 4MB RAM upgrade, $699; math coprocessor, $699; external keyboard, $99; numeric keypad, $149; extra battery, $299; car battery adapter, $65; external battery charger, $335; 2,400-bps data modem, $335; send/receive fax modem, $585; vinyl carrying case, $29; leather carrying case, $99.

CIRCLE 489 ON READER SERVICE CARD

PC LABS BENCHMARK TESTS

NEC UltraLite III

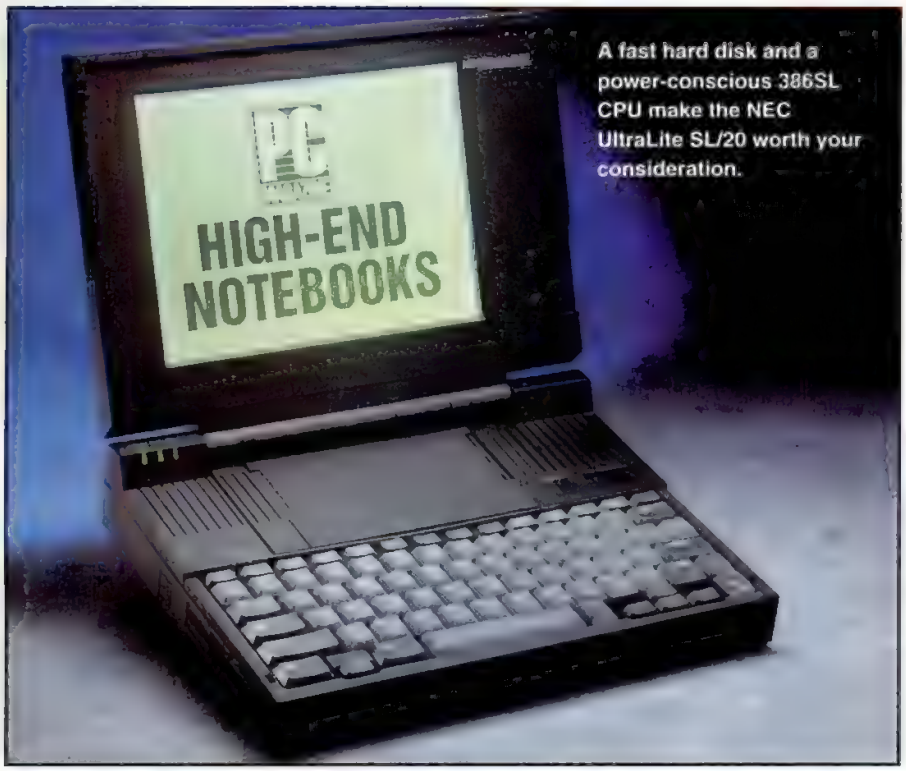
Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	87	87	263	111
Memory	1,396	1,396	4,795	2,162
Disk (seeks/second)	163	130	244	157
Video	1,621	478	3,030	1,286
Windows Graphics	1,312	745	2,175	1,273

In Short: The 4.8-pound NEC UltraLite III 386SX/20 notebook is ultralight only if you leave its external floppy disk drive home. But its performance is quite good for this system class and includes speedy disk and video scores. Good power-conservation features should compensate for an underwhelming Battery Rundown test score, and the $3,298 price is right.
Battery Life: 1 hour 45 minutes.

NEC TECHNOLOGIES INC.
NEC UltraLite SL/20

Based on the low-power-consumption Intel 386SL processor and aided by a 16K four-way set-associative RAM cache, the NEC UltraLite SL/20 combines good power conservation with good performance.

Priced at $3,799 (including both DOS and Windows 3.0), the 6.3-pound UltraLite SL/20 is no longer ultra light—especially when you tote its 1.3-



A fast hard disk and a power-conscious 386SL CPU make the NEC UltraLite SL/20 worth your consideration.

pound AC adapter. Unlike the NEC UltraLite III, however, the UltraLite SL/20 comes with an internal 1.44MB floppy disk drive. The 85MB Quantum GoDrive in the test unit is the largest available for this notebook and the fastest of all the systems in this review. Any options you want in the 2.2- by 11.5- by 9-inch case, such as memory upgrades or a modem, must be made by NEC at the time of purchase. The battery is the only component designed for easy access.

PC LABS BENCHMARK TESTS

NEC UltraLite SL/20

Test Scores (operations per second except where indicated)		Notebooks in this review Worst	Best	Average
Processor	99	87	263	111
Memory	2,236	1,396	4,795	2,162
Disk (seeks/second)	244	130	244	157
Video	1,323	478	3,030	1,286
Windows Graphics	1,290	745	2,175	1,273

In Short: The NEC UltraLite SL/20's 20-MHz 386SL CPU promises good power conservation, though the system achieved a Battery Rundown test score of only 2 hours 21 minutes at full power. Nevertheless, the $3,799 6.3-pound notebook benefited from a fast, 80MB hard disk and good performance across the board.
Battery Life: 2 hours 21 minutes.

The UltraLite SL/20 has separate mouse, keyboard, CRT, and serial ports, plus separate connectors for an external 1.44MB floppy disk drive, numeric keypad, and portable docking station. Its 9.5-inch supertwist nematic (STN) screen with cold-cathode fluorescent tube (CCFT) sidelighting makes for greater brightness and crispness at Super VGA resolution.

The UltraLite SL/20's performance was good on all of PC Magazine Labs' tests. Its video scores, aided by a 16-bit Western Digital video chip set, were above average. Its processor and memory scores were helped by a 16K four-way set-associative cache, and the Quantum GoDrive had the best score of the group because of its 16-millisecond seek time and internal 32K cache.

Besides the standard hard disk and video power-down, the 386SL processor allows three levels of power consumption, all of which you can specify during system setup. The idle mode, active only under battery power, automatically slows the CPU to 5 MHz and consumes 30 percent less power than standard operation. The rest mode, which lets a user-specified time-out suspend system operation while retaining RAM contents and system status, consumes 80 percent less power. The standby mode, which shuts down all possible devices, consumes 96 percent less power. Under full power, the 0.73-pound nickel cadmium battery lasted 2 hours 20 minutes on our Battery Rundown test—not the longest-lasting battery but among the most efficient.

The 78-key keyboard was sluggish. Most keys were full-size with standard 0.75-inch spacing from center to center; the 12 function keys were two-thirds size. The cursor keys, which were in an inverted-T layout, doubled as position keys when used with the Fn key.

The company's mail-in policy covers the NEC UltraLite SL/20 for one year on parts and labor and can be extended for a second year. You pay shipping charges both ways. Technical support is free; on-site service is available, but the price is not set.—*Mario Baldasserini*

FACT FILE

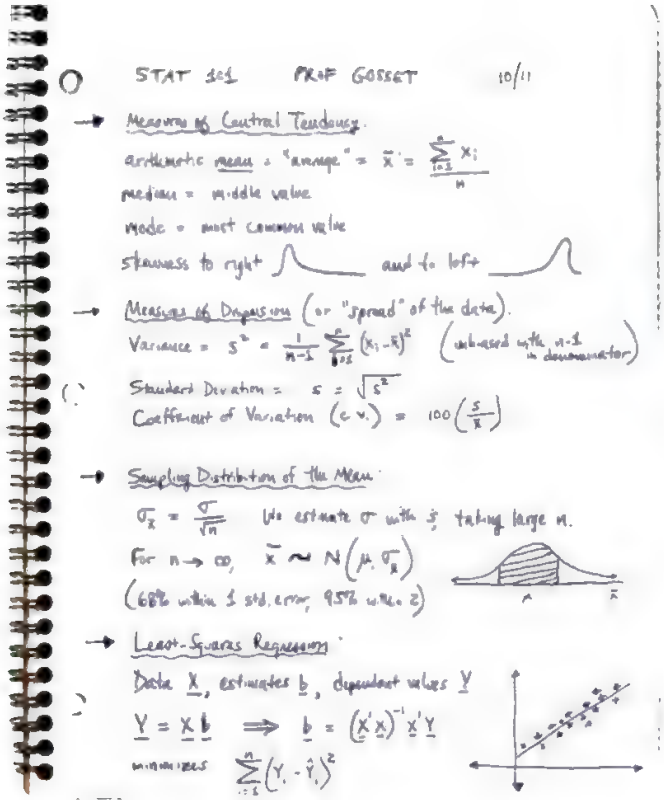
NEC UltraLite SL/20
NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 508-264-8000.
List Price (tested configuration): $3,799
Tested Configuration: 4MB RAM, 80MB Quantum hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $299; 6MB RAM upgrade, $1,099; external floppy disk drive, $290; math coprocessor, $699; numeric keypad, $149; extra battery, $149; car battery adapter, $65; 2,400-bps data modem, $335; send/receive fax modem, $585; leather carrying case, $99

CIRCLE 488 ON READER SERVICE CARD

PHILIPS CONSUMER ELECTRONICS CO.
Magnavox Metalis SX/20

The Magnavox Metalis SX/20, from Philips Consumer Electronics, has an impressive battery life, but its drawbacks include a flawed power-conservation feature and below-average video performance.

Our $3,398 test unit, which weighed 7.4 pounds and measured 2 by 11 by 8.5 inches, came with 4MB of RAM; a 19-millisecond 64MB hard disk (the largest available for this model) with a 32K buffer; parallel, serial, and mouse ports; and connectors for an external display, keypad, and bus. RAM can be expanded from 4MB to the 8MB maximum, but at great cost: You must remove the two proprietary 2MB DRAM SIMMs ($199 each)



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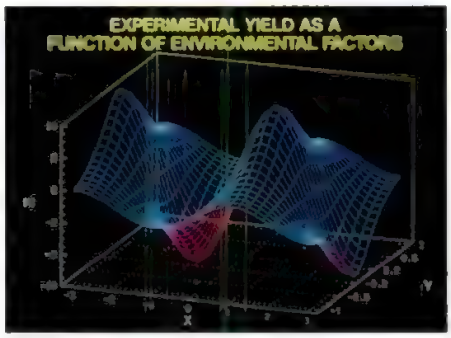

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PC MAGAZINE EDITORS' CHOICE

CIRCLE 365 ON READER SERVICE CARD

The 7.4-pound Magnavox Metalis SX/20, from Philips, was among the heaviest systems we tested.

and in their place install two new 4MB SIMMs ($799 each). A modem socket is visible, but Philips recommends having a trained technician handle installation of the combination 2,400-bps data- and 9,600-bps send-fax modem ($199) available for this unit.

The Metalis SX/20 posted below-average scores on PC Magazine Labs' processor, memory, video, disk, and Windows Graphics tests. Its poor video performance can be attributed to lack of a CMOS setting for fast-mode video. Although you can select the fast mode by using an included utility, the setting does not remain in effect after you power down your machine. It could also potentially violate the memory specifications of your system's DRAM or cause compatibility problems with some applications.

The display quality, however, was good. Text and graphics images were easy to read on this 8.5-inch sidelit triple-supertwist nematic (TSTN) screen. The unit has 12 function keys, and all screen adjustments are made with function-key combinations. The 80-key keyboard has near-full-travel keyposts and an inverted-T cursor-key layout. Position keys (Home, End, PgUp, and PgDn) require the Fn key.

The Metalis SX/20 lasted an impressive 3 hours 28 minutes on our Battery Rundown test, possibly due to its large 1.4-pound battery. Automatic power-down of the screen, hard disk, and CPU is adjustable during system setup. Our unit, however, did not automatically enter the next stage, standby mode, after waiting a preset interval. Pressing the standby button or closing the cover will cause it to enter standby mode under DOS, but not under Windows.

Philips backs its Magnavox line with one-year coverage on parts and labor. Its factory service centers guarantee a 72-hour turnaround, though you can pay $199 more for a rapid-response service that reduces turnaround time to 24 hours. Toll-free technical support is available weekdays 5 A.M. to 6 P.M. P.S.T. and Saturdays from 6 to 2:30.—*C. James Galley III*

PC LABS BENCHMARK TESTS 4.0

Philips Magnavox Metalis SX/20

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	90	87	263	111
Memory	1,528	1,396	4,795	2,162
Disk (seeks/second)	144	130	244	157
Video	1,036	478	3,030	1,286
Windows Graphics	745	745	2,175	1,273

In Short: Though the $3,398 Magnavox Metalis SX/20's battery life is impressive, its other test scores (particularly video) are less so. At 7.4 pounds, the system is among the heaviest we tested, and you must push a button or close the system's cover to enter the standby mode. Its internal modem options are good, with features including send/receive fax capabilities and MNP 5 error correction.
Battery Life: 3 hours 28 minutes.

PC FACT FILE

Magnavox Metalis SX/20
Philips Consumer Electronics Co., One Philips Dr., Knoxville, TN 37914-1810; 800-835-3504
List Price (tested configuration): $3,398
Tested Configuration: 4MB RAM, 64MB Conner hard disk, 1.44MB floppy disk drive, DOS 4.01, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $399, 4MB RAM upgrade, $799; external floppy disk drive, $299; numeric keypad, $99; expansion chassis, $699; extra battery, $99; extra AC power adapter, $149; 2,400-bps data/9,600-bps send-fax modem, $199; 9,600-bps (MNP 5) data/fax modem, $399; system carrying case, $129

CIRCLE 487 ON READER SERVICE CARD

PHILIPS CONSUMER ELECTRONICS CO.
Philips LX320

The sturdy, 386SX/20-based Philips LX320 has good processor performance for a 386SX/20, but its video and power-management features are limited.

The 6.4-pound Philips LX320 we tested held 4MB of RAM, a 64MB hard disk with a 32K buffer, a 1.44MB floppy disk drive, and an internal 2,400/9,600-bps modem with send-only fax in a stylish 1.8- by 11- by 9-inch case. Philips has

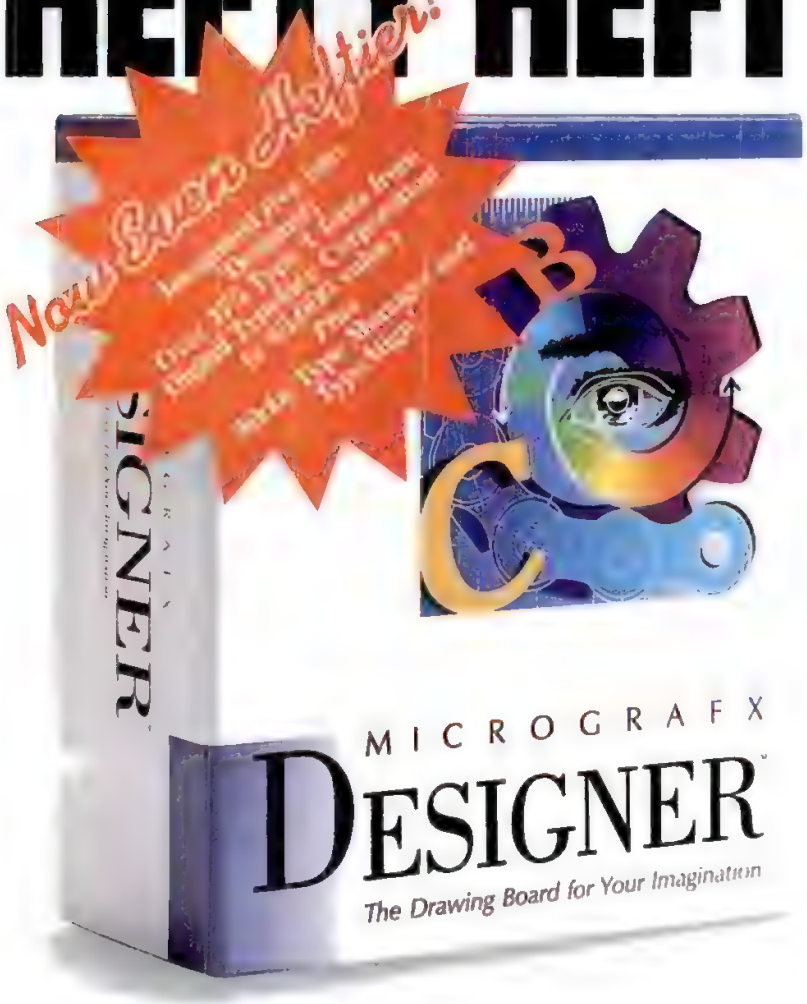
PC LABS BENCHMARK TESTS 4.0

Philips LX320

Test Scores (operations per second except where indicated)		Notebooks in this review: Worst	Best	Average
Processor	99	87	263	111
Memory	1,885	1,396	4,795	2,162
Disk (seeks/second)	149	130	244	157
Video	750	478	3,030	1,286
Windows Graphics	949	745	2,175	1,273

In Short: A sturdy 386SX/20 notebook, the $3,698 Philips LX320 is middle-of-the-road in its price, performance, and features. At 6.4 pounds, it is comfortable to carry, and its battery score of 2 hours 25 minutes is respectable if not overwhelming. But this PC's video score was somewhat disappointing. Its video-speed utility boosts performance for many applications but may cause compatibility problems.
Battery Life: 2 hours 25 minutes.

HEFTY HEFTY HEFTY



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Features	Designer	Corel Draw
Drawing layers	64	1
Dimensioning	Yes	No
Object snap	Yes	No
Maximum drawing size	132″ × 132″	17″ × 17″
Edit in full color	Yes	No
Clip art images	Over 1,700	750
Type 1 fonts	180	0
PageMaker 4.0 filter	Yes	No
On line help screens	Yes	No
24-hour support	Yes	No

> **The experts' verdict:**
> **"No contest."**
> *Software Digest* gave Designer five stars to Corel's three, concluding: ***"Designer provides the best overall free-form graphics package. It offers state-of-the-art features, good performance, and unmatched ease of learning and use in a sophisticated package."***

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Designer system requirements: 286 (386 recommended) IBM PC or compatible, or PS/2. 1 MB RAM (2 MB RAM recommended). 20 MB (or larger) hard disk. Windows 3.0. DOS 3.1 (or higher). Mouse or digitizing pad. Windows-compatible monitor.

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TOSHIBA T2000SX 16 MHz i386SX SYSTEM.

System includes 2 MB RAM, 40 MB Hard Drive, VGA LCD, 3.5" floppy drive, 10" x 12.2" x 1.9" dimensions.

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CIRCLE 043 ON READER SERVICE CARD

FACT FILE

Philips LX320
Philips Consumer Electronics Co., One Philips Dr., Knoxville, TN 37914-1810; 800-835-3504.
List Price (tested configuration): With 80MB hard disk, $3,698.
Tested Configuration: 4MB RAM, 64MB Conner hard disk (discontinued), 1.44MB floppy disk drive, DOS 4.01, AC power adapter, carrying case.
Options: 2MB RAM upgrade, $399; numeric keypad, $99; expansion chassis, $699; extra battery, $99; extra AC power adapter, $149; 2,400-bps data/9,600-bps send-fax modem, $199; system carrying case, $129.

CIRCLE 490 ON READER SERVICE CARD

since dropped the 64MB disk in favor of a larger-capacity 80MB model, but the system is otherwise identical. That system sells for $3,698, plus $199 for the modem.

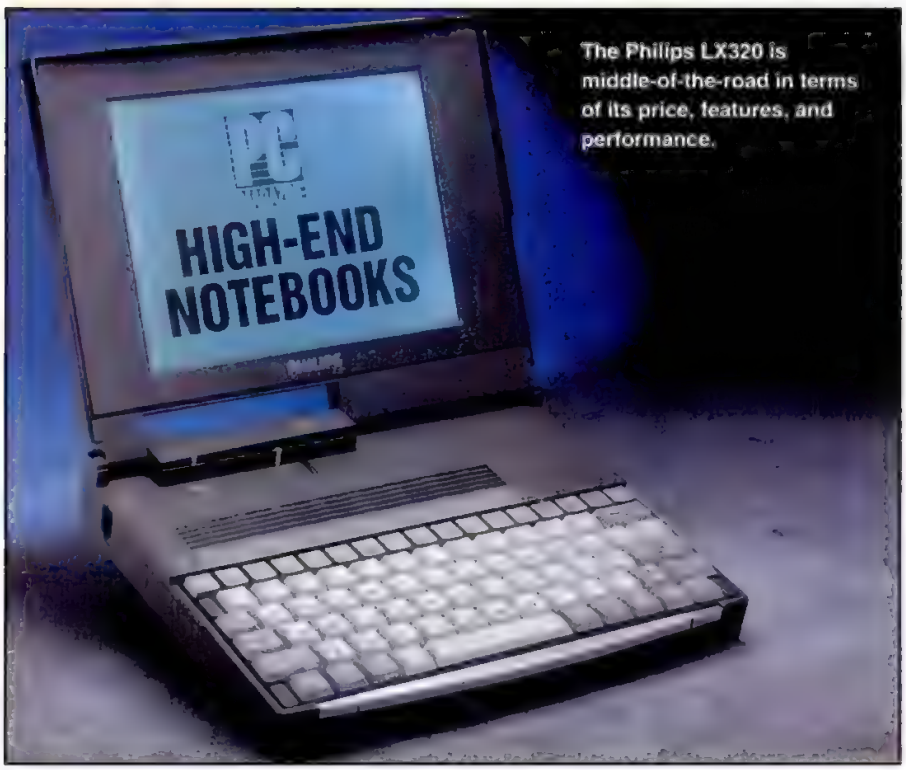
The system's ergonomics are good. A recessed panel covers the tightly arranged parallel, serial, mouse, keyboard, VGA, and dual phone-jack connectors. Pressing two buttons flips the keyboard up and reveals a battery compartment underneath. To install a math coprocessor or a modem ($199), or a proprietary 2MB module ($199) for the 6MB RAM maximum, simply remove the expansion cover next to the battery compartment.

The Philips LX320's 9.5-inch sidelit screen displays 16 shades of gray at 640-by-480 resolution. Function-key combinations adjust contrast, brightness, and reverse video from the keyboard. The quiet 80-key keyboard has excellent tactile feedback, 12 function keys, and an inverted-T cursor-key layout. Home, End, and Pg keys require the Fn key.

The Philips LX320's memory and disk test results were decidedly middle of the road. Its processor scores, while average for the machines in this review, were among the best compared with those of other 386SX/20-based machines. Its video performance, however, was well below average because the unit's default video mode was slow. A utility program lets you change to fast mode, but this setting does not remain in effect after you power down and could potentially cause compatibility problems.

The Philips LX320's 1.2-pound nickel cadmium battery lasted 2 hours 24 minutes on our Battery Rundown test. The two power-conservation modes are doze and sleep. The doze mode, factory-set to 2 seconds, slows the clock speed to 2 MHz. The sleep mode, which activates after 2 minutes, powers down the screen, disk drives, ports, and all keyboard LEDs. You can set both modes in CMOS. Both work fine with standard DOS applications, but certain Windows applications (such as Windows Write and Notepad) that have a blinking cursor will stop the machine from entering sleep mode.

Philips backs its systems with a one-year coverage on parts and labor and guarantees 72-hour turnaround at Philips factory service centers. A rapid-response service program that reduces turnaround time to 24 hours costs an extra $199. Toll-free technical support is available weekdays 5 A.M. to 6 P.M. P.S.T. and Saturdays from 6 to 2:30.—*C. James Galley III*



The Philips LX320 is middle-of-the-road in terms of its price, features, and performance.

TEXAS INSTRUMENTS INC.
TI TravelMate 3000 WinSX

With an eye to the emerging class of Windows-ready notebooks, Texas Instruments has essentially repackaged its TI 386SX/20 TravelMate 3000 as the Windows-oriented TI TravelMate 3000 WinSX.

Our $3,599 test unit came with 4MB of proprietary user-installable RAM, a socket for an 80387SX or Cyrix 387 coprocessor, an 80MB Conner CP-2084 hard disk, a front-accessible 1.44MB floppy disk drive, a hand-held trackball, Windows 3.0 preloaded, and a number of Windows-based notebook utilities. It weighed 7.1 pounds with battery and measured 2 by 11 by 9 inches. Parallel, serial, external VGA, and PS/2 mouse ports are on the left; a keypad connector is on the right. The internal modem is optional.

Contrast ratio adjustments are only fair on this 10-inch, sidelit, triple-supertwist VGA-compatible screen, and text displays look somewhat muted in bright light. The

FACT FILE

TI TravelMate 3000 WinSX
Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; 800-527-3500.
List Price (tested configuration): $3,599.
Tested Configuration: 4MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, mouse, AC power adapter, carrying case
Options: 2MB RAM upgrade, $299; upgrade to 120MB hard disk, $400; math coprocessor, $739; numeric keypad, $69; extra battery, $99; extra AC power adapter, $120; 2,400-bps data modem, $299; send/receive fax modem, $299; 9,600-bps (V.42bis) data modem, $899; leather carrying case, $49.

CIRCLE 491 ON READER SERVICE CARD

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Available in AT, SCSI-2 and Fast SCSI-2 interfaces, the drives combine a 3,600 RPM or 4,500 RPM spindle motor with Zone Bit Recording (ZBR) to offer access times as low as 9.9 msec. Power consumption is from 3.5 to 5 watts, and capacities range from 106 to 525 formatted megabytes.

When creativity and craftsmanship combine, the result is art. For complete product specifications, contact your authorized Seagate distributor or call Seagate directly at 800-468-DISC or 408-438-6550.

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TravelMate 3000 WinSX's LCD screen has 32 shades of gray and can display color on an external VGA screen. PAL and RPAL, the palette adjustment utilities, allow keystroke selection of palettes and adjustable palette definitions. You can save custom palettes to disk files and set up different palettes to correspond to different applications. Cursor customization is possible under Windows.

The 79-key keyboard, which includes 12 top-row function keys, has a good feel. To use the Home, End, PgUp, and PgDn keys, you must activate the Fn key.

Texas Instrument's user-adjustable BatteryPro power-management utilities control four levels of power saving for the disk, video, and CPU. A closed-cover suspend mode shuts off the LCD and disks and disables interrupt servicing, but a manual standby mode similar to the suspend mode still services task interrupts. You can specify an interval that will blank the screen, put the system into suspend mode, or wake it from suspend mode.

On PC Magazine Labs' benchmark tests, the TravelMate 3000 WinSX placed slightly ahead of the other 386SX/20 systems in terms of PC Magazine Labs' Hardware Performance Tests, Release 6.0's video test and the Windows Graphics benchmark test, but it yielded lackluster performance on our disk test. Its processor and memory performance was in line with that of similar systems. Battery rundown under full power took 2 hours 23 minutes.

The company has spent time engineering and documenting the system functionality to minimize startup delays. Comprehensive user manuals have many detailed diagrams describing system features, installation of options, and power-management utilities. AUTOEXEC.BAT and CONFIG.SYS files are preconfigured for Windows use, and Windows is set up and ready to use out of the box. You can hold the TravelPoint trackball in your hand or affix it to the system's side.

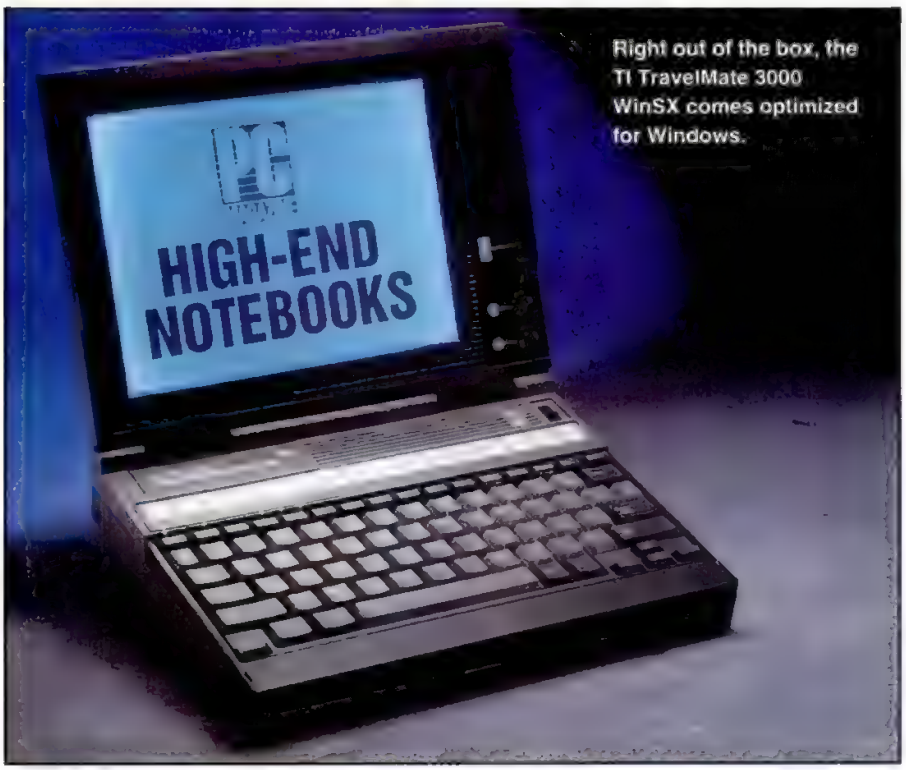
Texas Instruments provides one year of free warranty service directly or through authorized resellers. Technical support is free but requires a toll call. On-site service and extended warranty plans are optional.
—*Nick Stam*

PC LABS' BENCHMARK TESTS 6.0

TI TravelMate 3000 WinSX

Test Scores (operations per second except where indicated)		Notebooks in this review Worst	Best	Average
Processor	**91**	87	263	111
Memory	**2,033**	1,396	4,795	2,162
Disk (seeks/second)	**130**	130	244	157
Video	**1,354**	478	3,030	1,286
Windows Graphics	**1,420**	745	2,175	1,273

In Short: Texas Instruments makes Windows easy. With the software preloaded on the hard disk, a mini-trackball, and AUTOEXEC.BAT and CONFIG.SYS files preconfigured for Windows use, your TI TravelMate 3000 WinSX can be up and running in no time. Otherwise, this is about the same basic $3,599 386SX/20 unit that has been on the market for the past year.
Battery Life: 2 hours 23 minutes.



Right out of the box, the TI TravelMate 3000 WinSX comes optimized for Windows.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.
Toshiba T2200SX

The Toshiba T2200SX offers great portability and a long battery life. This lightweight 386SX/20 is the only notebook in this review that gives you a 3-hour battery life yet weighs less than 7 pounds with its adapter.

Our $4,778 test configuration weighed 5.6 pounds with its nickel hydride battery. An optional 2MB expansion card brought the installed 2MB of RAM to 4MB; you can add RAM yourself by plugging in a credit-card-size module containing 2MB, 4MB, or 8MB of memory. Its 1.6- by 11.7- by 8.3-inch case houses a 19-millisecond 60MB Conner hard disk and a 1.44MB floppy disk drive.

An external 2,400-bps credit-card-size modem that plugs directly into the side of the unit is also available. Priced at $459, it has MNP 5 data compression and V.42bis error correction. Designed for this system's card slot, the odd-looking device is lightweight and small, but its RJ-11 jack dangles outside the notebook.

FACT FILE
EDITORS' CHOICE

Toshiba T2200SX
Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445.
List Price (tested configuration): $4,778.
Tested Configuration: 4MB RAM, 60MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter.
Options: 2MB RAM upgrade, $479; 4MB RAM upgrade, $889; 8MB RAM upgrade, $1,779; external floppy disk drive, $399; external keyboard, $159; numeric keypad, $79; extra battery, $199; extra AC power adapter, $139; car battery adapter, $129; 2,400-bps external data modem, $459; standard carrying case, $79; leather carrying case, $105.

CIRCLE 492 ON READER SERVICE CARD

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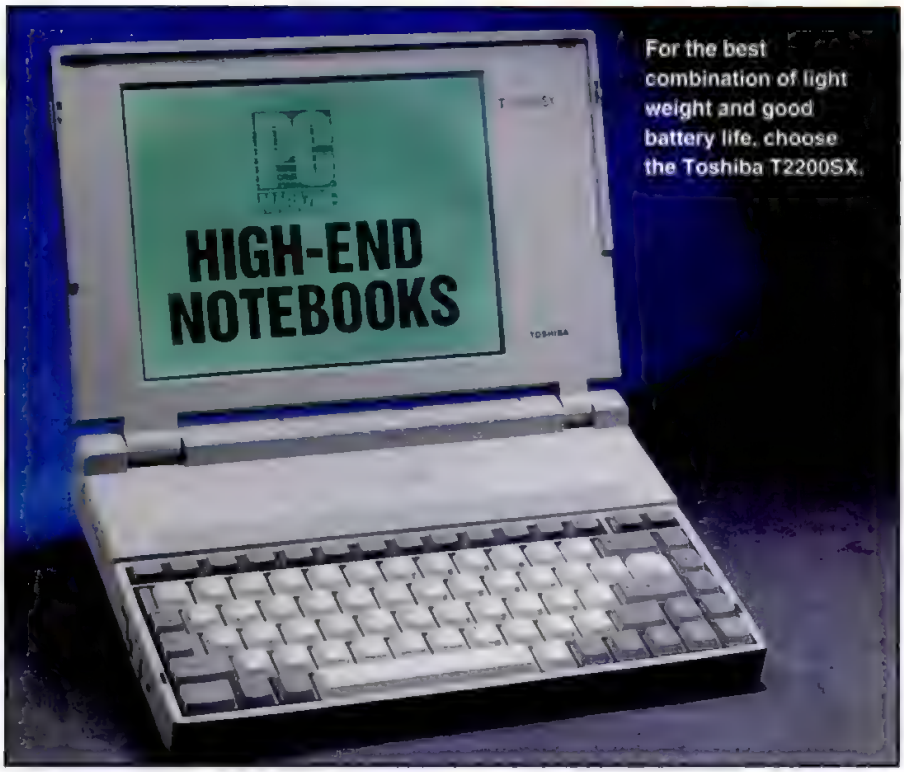


For the best combination of light weight and good battery life, choose the Toshiba T2200SX.

The back panel contains ports for parallel, serial, and external VGA connectors, as well as a proprietary port that accepts a Toshiba expansion chassis. Other ports accept a PS/2-style mouse and a numeric keypad; a power switch doubles as a standby/resume switch, allowing you to shut down your system but return to your application later and pick up at the same point you left it.

The 9.5-inch sidelit LCD panel supports 16 shades of gray at VGA resolution. The 82-key keyboard has standard 0.75-inch spacing, 12 function keys, plus dedicated position keys and an inverted-T cursor-key layout.

The Toshiba T2200SX's nickel hydride battery sustained the system for 3 hours 19 minutes under full power on PC Magazine Labs' Battery Rundown test. A pop-up control panel handles screen and power conservation. Integrated into CMOS, this utility does not require you to reboot after you change the configuration. The system also has an intelligent gauge that indicates the remaining battery life. Standby/resume shuts the system down and brings you back to your data at the same point you left it. You can set timeout intervals for the disk, display, and processor.

In terms of its processor, memory, and disk scores, the Toshiba T2200SX yielded slightly below-average results when compared with similarly configured 386SX/20 laptops in this review. Toshiba America Information Systems, however, based the video subsystem on a Western Digital chip set, and this notebook proved to be the second-strongest performer on our video benchmark test. In addition, its Windows benchmark test score was above average.

The Toshiba T2200SX comes with a one-year warranty on parts and labor; the cost of extending the warranty depends on the amount of service you desire. Toshiba also offers an international warranty, which it extends to twenty industrialized countries. Technical support is toll-free, and a bulletin board service and access to Toshiba's CompuServe Forum are also available.—*William Bettini*

PC LABS' BENCHMARK TESTS 6.0

Toshiba T2200SX

Test Scores (operations per second except where indicated)		Notebooks in this review Worst	Best	Average
Processor	89	87	263	111
Memory	1,949	1,396	4,795	2,162
Disk (seeks/second)	146	130	244	157
Video	1,826	478	3,030	1,286
Windows Graphics	2,175	745	2,175	1,273

In Short: The $4,778 Toshiba T2200SX is a notebook no other 386SX can beat: It weighs less than 6 pounds, has a battery life of more than 3 hours at full power, and includes Toshiba's famous auto-resume feature. But what's that dangling outside? It's the RJ-11 jack attached to the credit-card modem, which does not fit inside the case. It is a bother to carry, but you may be glad you have it with you.
Battery Life: 3 hours 19 minutes.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.
Toshiba T4400SX

The Toshiba T4400SX occupies a special place in the laptop world: It is the first battery-powered 25-MHz 486SX on the market, and it even has room for a CPU upgrade.

When you purchase this notebook, you must choose between two types of screen display: gas plasma, with 16 shades of gray ($6,334 for a unit with 4MB of RAM), or a supertwist LCD screen that displays 64 shades of gray and has fluorescent sidelighting ($6,034 with 4MB of RAM). Our test model had the LCD screen, and a $1,335 memory module increased system memory to its 10MB maximum. The total price came to $6,934.

The Toshiba T4400SX ships with a 19-millisecond 80MB Conner hard disk and an internal 1.44MB floppy disk drive. Its back panel has connectors for parallel, serial, VGA, PS/2-style mouse, and proprietary expansion ports. An expansion plug on the left side of the case accepts an external numeric keypad and a connector for the internal modem. For some years now, Toshiba America Information Systems has been marketing a 2,400-bps

PC LABS' BENCHMARK TESTS 6.0

Toshiba T4400SX

Test Scores (operations per second except where indicated)		Notebooks in this review Worst	Best	Average
Processor	263	87	263	111
Memory	4,795	1,396	4,795	2,162
Disk (seeks/second)	156	130	244	157
Video	1,758	478	3,030	1,286
Windows Graphics	1,259	745	2,175	1,273

In Short: First, the raw power of the Toshiba T4400SX's 25-MHz 486SX CPU will give you a jolt. Four hours later, you will start to think about changing the battery. Though the $5,599 7.4-pound Toshiba T4400SX is expensive and heavier than any other notebook in this review, nothing this size or shape beats its battery life or its processor and memory speed.
Battery Life: 4 hours 19 minutes.

Rattle Your Window Panes.

"...SX/Now! is the undisputed performance champ..."

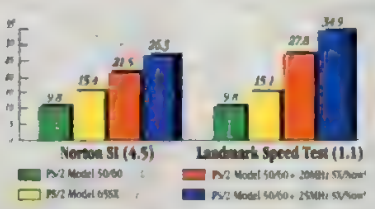
PC Magazine, Oct. 29, 1991

"...SX/Now! upgrades offer polish as well as good fit, performance and compatibility..."

PC Week, Aug. 26, 1991

Want to make your Windows really shine? For Windows enhanced mode, multitasking and memory management, **SX/Now!** 386SX processor upgrades from Kingston are the way to get optimum 386 performance without replacing your 286 system.

Our new **Am386SX 25MHz CPU** upgrade increases the processing performance of your 286 system by over 350%.* As with our 20MHz version, we combine a microprocessor with a 16KB memory cache and on-board clock plus support for a 387SX co-processor—all on a module that doesn't take up or interfere with an expansion slot.



What about compatibility? **SX/Now!** supports a wide range of 286 based systems, DOS 5.0, Windows and OS/2. **SX/Now!** versions are certified by the National Software Testing Lab for full hardware and software compatibility.

And with Kingston's five year warranty, you know that an **SX/Now!** upgrade won't let you down.

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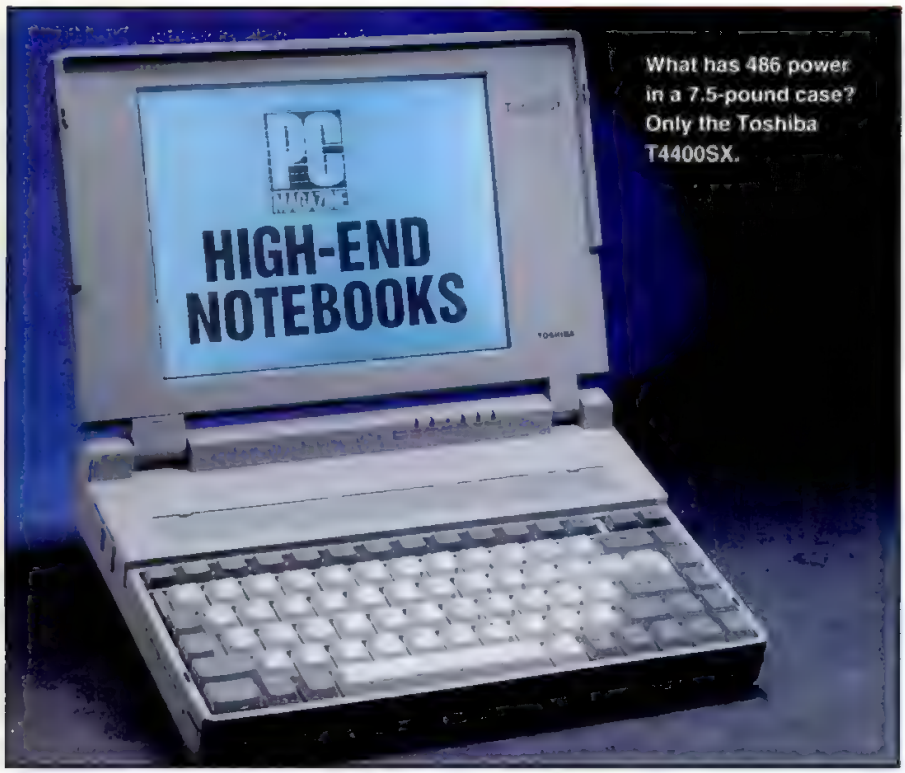

What has 486 power in a 7.5-pound case? Only the Toshiba T4400SX.

modem that fits the Toshiba T4400SX and other Toshiba laptops. Priced at $459, it has MNP 5 data compression and V.42bis error correction. A more advanced version expected to ship soon will have 9,600-bps fax.

Other options include an external 1.2MB floppy disk drive, an external tape backup unit, a two-slot docking station, an internal modem, and a 486DX/25 processor upgrade. The 82-key keyboard has full-size keys with standard 0.75-inch spacing, 12 function keys, an inverted-T cursor-key layout, and dedicated position keys.

On PC Magazine Labs' Battery Rundown tests the Toshiba T4400SX's 2.3-pound nickel cadmium battery sustained it for 4 hours 18 minutes under full power. A pop-up panel lets you select power-conservation features and screen settings; a gas-gauge indicator shows how much battery life you have left. The power switch can double as an auto-resume switch.

As you would expect, the Toshiba T4400SX's performance on our processor and memory tests was the best of the group because of the 486SX chip's internal 8K four-way set-associative cache and its inherently faster memory access times. The Conner CP-2084 IDE hard disk that came with the system yielded average results on our disk test. Its video performance, however, was above average on both PC Magazine Labs' video and Windows Graphics tests.

The Toshiba T4400SX's warranty covers parts and labor for one year and Toshiba America Information Systems can extend it for another two years at a price that depends on the system cost and how much service you want. Technical support is toll-free.—*William Bettini*

FACT FILE
EDITORS' CHOICE

Toshiba T4400SX
Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445.
List Price (tested configuration): $6,934.
Tested Configuration: 10MB RAM, 80MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter.
Options: 2MB RAM upgrade, $435; 4MB RAM upgrade, $699; 8MB RAM upgrade, $1,335; external floppy disk drive, $399; external keyboard, $159; numeric keypad, $79; extra battery, $345; extra AC power adapter, $185; car battery adapter, $199; 2,400-bps external data modem, $459; standard carrying case, $79; leather carrying case, $105.

CIRCLE 493 ON READER SERVICE CARD

ZENITH DATA SYSTEMS
ZDS MastersPort 386SLe

Based on the 25-MHz version of the low-power Intel i386SL processor, the ZDS MastersPort 386SLe combines a small size with excellent performance.

The MastersPort measures 1.8 by 12.4 by 8.3 inches and weighs 7.1 pounds. Our $4,398 test unit held a 25-MHz i386SL processor, 4MB of RAM, an 85MB Conner hard disk, an internal 1.44MB floppy disk drive, a dual-voltage power supply, and DOS 5.0. This price includes a 2,400-bps modem with MNP 5 data compression ($349); a send-only fax modem would cost $499. Windows 3.0 is also bundled at the same price.

Zenith Data Systems makes expansion easy. You can add RAM by installing three 2MB memory modules ($399 each) to reach the system's 8MB maximum. The optional modem slips easily into a slot on the unit's left side, and an easy-access panel on the bottom of the unit covers a socket for a 25-MHz 80387SX coprocessor ($449).

The MastersPort performed impressively. On PC Magazine Labs' processor and memory benchmark tests, its times were about par with those of the Compaq LTE Lite/25 and substantially better than those of the AST Premium Exec 386SX/20, which contains a 25-MHz Am386SXL chip. This above-average performance can be credited to the system's 64K processor RAM cache. The benchmark test results for the video and disk subsystems were not as stellar as the memory and processor results but were still above average.

On our Battery Rundown test, the

FACT FILE

ZDS MastersPort 386SLe
Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331.
List Price (tested configuration): $4,398.
Tested Configuration: 4MB RAM, 85MB Conner hard disk, 1.44MB floppy disk drive, DOS 5.0, AC power adapter.
Options: 2MB RAM upgrade, $399; math coprocessor, $449; external floppy disk drive, $299; external keyboard, $129; numeric keypad, $129; extra battery, $115; AC power adapter, $139; car battery adapter, $219; 2,400-bps data modem, $349; 2,400-bps data/9,600-bps fax modem, $499; standard carrying case, $89.

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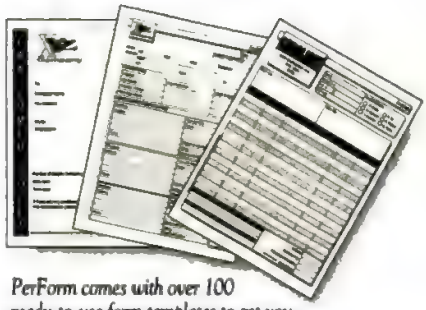

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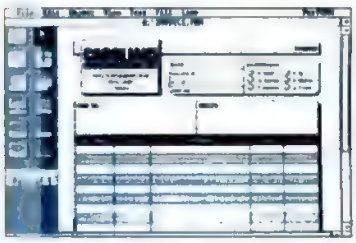

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PC LABS' BENCHMARK TESTS

ZDS MastersPort 386SLe

Test Scores (operations per second except where indicated)		Notebooks in this review Worst	Best	Average
Processor	127	87	263	111
Memory	2,594	1,396	4,795	2,162
Disk (seeks/second)	152	130	244	157
Video	1,357	478	3,030	1,286
Windows Graphics	1,345	745	2,175	1,273

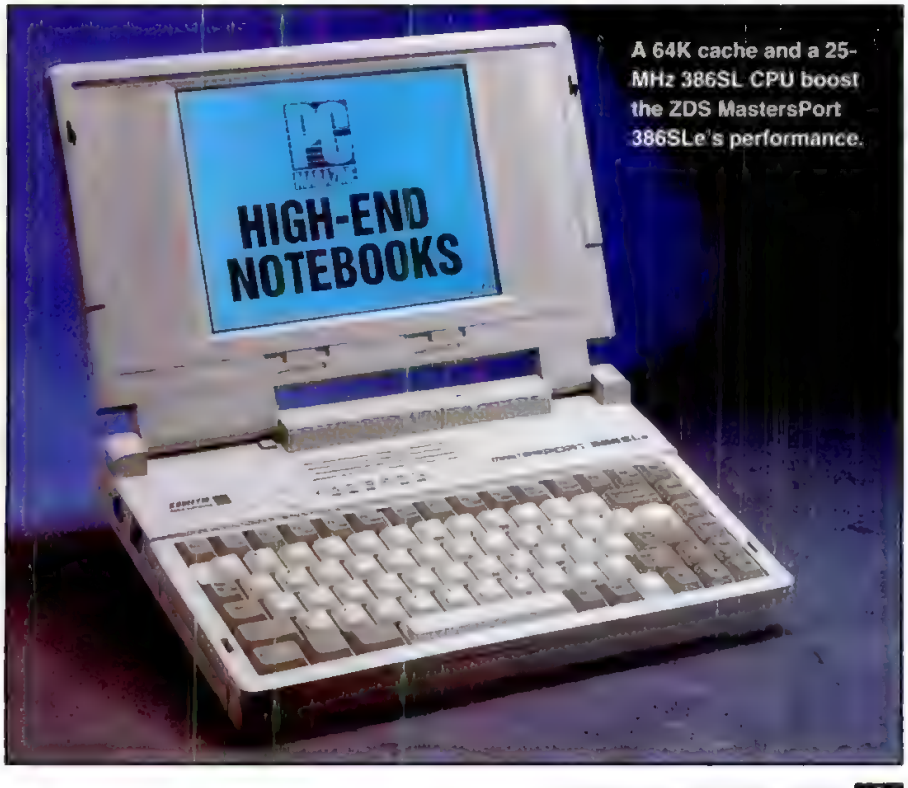
In Short: ZDS pioneered the 386SL notebook and has now improved on it by introducing a 25-MHz, 64K-cache version. Even so, ZDS may have coaxed the extra performance from the 7.1-pound $5,247 ZDS MastersPort 386SLe at the cost of some extra battery life. Features such as a flash BIOS and an enhanced parallel port for high-speed network connection show the MastersPort's best side.
Battery Life: 2 hours 53 minutes.

MastersPort's 1.3-pound nickel cadmium battery lasted 2 hours 53 minutes under full power. Comprehensive power-conservation features keep it going much longer, however. Four user-adjustable timers govern hard disk power-down, screen backlighting, auto-standby, and auto-rest. The auto-standby mode stops the processor clock, video subsystem, and hard disk motor; ZDS claims that the MastersPort can last six days in this mode. The auto-rest mode goes one step further and shuts off everything except the memory and memory-control system; in this mode the MastersPort can last more than two weeks. You can configure the power switch to either power down the MastersPort or put it into rest mode.

The MastersPort's innovative design does not stop here. A high-speed Enhanced Parallel Port (EPP) eliminates the performance degradation normally encountered when connecting a notebook computer to a LAN. Another feature, flash memory, allows you to upgrade the BIOS through CompuServe or ZDS's bulletin board as soon as updates become available.

A supertwist LCD with cold-cathode fluorescent tube (CCFT) backlighting illuminates the MastersPort's 9-inch screen; keyboard function-key combinations make the brightness and contrast adjustments. The 82-key keyboard has an inverted-T cursor-key layout and separate Home, End, PgUp, and PgDn keys in a vertical row along the right side of the keyboard.

ZDS backs its systems with one-year coverage on parts and labor. On-site service is available for $93 for the first year, and authorized factory service centers guarantee a 72-hour turnaround. Toll-free technical support is available 5 A.M. to 6 P.M. P.S.T. weekdays and 6 A.M. to 2:30 P.M. Saturdays.—*Charles Rodriguez* ■



A 64K cache and a 25-MHz 386SL CPU boost the ZDS MastersPort 386SLe's performance.

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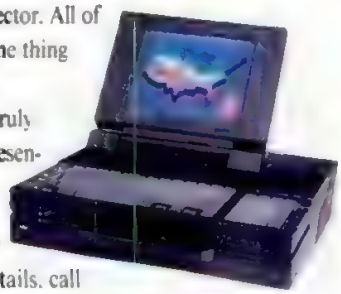

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CIRCLE 021 ON READER SERVICE CARD

Minicartridge Tape Backup

Simple, Inexpensive, And QIC

Backing up was hard to do, but these 13 DC-2000 minicartridge drives are quick and easy to use. The prices are appealing, too, averaging $700 for an external unit that can store up to 250MB of data.

PHOTOGRAPHIC DIRECTOR: ROBERT GOULD

BY WINN L. ROSCH Consider tape backup as castor oil for your computer: unpalatable and with little perceived value. You take it only because it's good for you in some way that you never hope to encounter. No matter how much sugar is mixed in with it, you still wish it—and the need for it—would go away.

Unfortunately, the need to back up your data is not going to disappear, and it's up

to the tape drive vendors to make the job as painless as possible. Like patent drug manufacturers, backup system vendors constantly seek the right combination of medicine, variety, and hype to score a marketplace win. Today's popular winner is the minicartridge.

Minicartridges are quarter-inch tapes based on a dual-hub system developed by 3M Corp. two decades ago and now stuffed into shells, generally termed DC-2000, measuring 2.4 inches deep and 3.2 inches wide in their smallest form factor. For typical single-user PC hard disks (with capacities ranging from about 80MB to 100MB) or even for small networks, minicartridges offer a cure for backup that's flavored with good speed (as much as 2MB per minute when you include verification), low prices, and easy-to-use software.

PC Magazine examines 13 minicartridge systems from Alloy Computer Products, Colorado Memory Systems, CORE International, Everex Systems, Irwin Magnetic Systems, Maynard Electronics, Micro Solutions, Mountain Network Solutions, Summit Memory Systems, Tallgrass Technologies Corp., Tecmar, and Wangtek. Though manufacturers of minicartridge drives report that internal drives typically make up about 80 percent of their sales, testing considerations led us to concentrate primarily on external drives for this review. Additionally, external drives are functionally identical to internal units (the only effective difference is that you need a free drive bay for an internal system), yet their design allowed us to judge each manufacturer's complete package, including cases, cables, and often interfaces or controllers.

LOOK AT THE COST

Retail prices for the external drives range from just a little over $500 to $1,149 for a unit without an accelerated controller, and they average about $700. Internal versions of the units represented here don't require cases or connecting cables, and therefore are less costly options. They average about $500 and can go as low as $350. However, if you need to back up several PCs, you can justify the extra expense of an external drive by using one drive to service them all.

All internal versions of the external tape drives we reviewed fit into a standard full-height 3.5-inch bay and include installation kits to adapt them to 5.25-inch bays.

OUR CONTRIBUTORS

Oliver Rist is a staff editor of *PC Magazine*.
Mitt Jones and **Winn L. Rosch** are contributing editors of *PC Magazine*.
Kellyn Betts, Joseph Desposito, and **Ed Perratore** are frequent contributors to *PC Magazine*.

HIGHLIGHTS: Minicartridge Tape Backup

- QIC-80 and proprietary formats that offer the same minicartridge capacity (up to 250MB with data compression using extended-length DC-2000–series tape) are good, inexpensive performers. On the average, external tape drives sell for around $700, and internal units are available for about $500, although some of the best internal units list for as little as $350. Internal tape drives fit into half-height 3.5-inch bays or 5.25-inch bays. Even with verification enabled, you can still back up at the rate of 2MB per minute.

- QIC-80 is the fastest-growing tape drive product category. By next year sales should reach half a million and easily surpass the old QIC-40 standard, which QIC-80–based drives can also read.

- The QIC-80 standard allows complete compatibility with tape drives following its format. This means that you should be able to format a tape on one manufacturer's drive and use it in another.

- Many vendors claim QIC-80 compatibility, but not all systems are fully QIC-80–certified. Currently, the certified units reviewed include only the Colorado Memory Systems Jumbo 250 External, the Maynard ArchiveXL 5580e Tape Backup, and the Mountain FileSafe External 8000Plus subsystems.

- The QIC-80 systems available now are not always 100 percent reliable; with some drives, we experienced problems using preformatted tapes supplied by the companies. Preformatted tapes can save you time, but for safety's sake, you'll probably want to format tapes yourself.

- In their standard configurations, most of these systems operate at 500 kilobits per second. However, some tape drives offer accelerated controllers as standard equipment (or as options) to boost operating speed to 1 megabit per second.

- Software is a key buying consideration. In general, the software accompanying the tape drives has become easier to use; most of the products now provide menu-driven interfaces, and two of the vendors—Irwin Magnetic Systems and Summit Memory Systems—include both DOS and Microsoft Windows versions with their systems. The software's ability to verify data and format tapes is important as well.

- Many of the products reviewed here claim compatibility with third-party software packages, such as *Sytos* and *PC Tools*. In addition to the Summit Express SE250 Tape Backup and the Wangtek E3080PK, which both ship with *Central Point Backup*, other products also claim to work with the *Central Point* package. Third-party software presents an attractive option, but using your vendor's proprietary software gives you the advantage of a package tailored specifically for your system.

- The minicartridge systems reviewed in this issue are fine for single users and can be used on small networks. For larger networks, DC-6000, DAT, or 8-mm. tape drives are better alternatives. ■

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WHAT'S THIS QIC-80 THING?

QIC-80 minicartridge drives are expected to be the fastest-growing subgigabyte backup choice for the next few years. According to Freeman Associates, a consulting firm based in Santa Barbara, California, U.S. unit sales are expected to increase 26 percent this year (from 315,000 to 398,000), overtake the preceding QIC-40 standard by 1993 (459,000 versus 322,000), and peak (at 486,000 units) in 1994. QIC-80 improves on its QIC-40 predecessor by doubling its capacity. The QIC-80 standard also allows complete compatibility among drives following its format; this means you can format a tape on one maker's drive and use it in another's.

To become fully QIC-80–certified, a manufacturer must submit a system to the Pericomp Corp. (Natick, Maine), where it must pass a suite of tests defined by the QIC committee. The drives arriving at PC Magazine Labs fell into three categories:

- Non–QIC-80–compatible; the drive didn't work on the QIC-80 standard. Only the Irwin AccuTrak Plus A250E fell into this category.
- QIC-80–compatible; the drive manufacturer claimed to conform to the QIC-80 standard, but the drive had not yet been approved by the Pericomp testing facility. The Alloy Retriever/250ce, the COREtape Light, the Everex Excel 120F, the Micro Solutions Backpack Tape Drive (the only product using a parallel-port interface), the Summit Express SE250 Tape Backup, the Tallgrass FS250e and FS300e, the Tecmar MiniVault 250, and the Wangtek E3080PK fell into this slot.
- QIC-80–approved; the drive subsystem had been tested and certified compatible by Pericomp. Only the Colorado Memory Systems Jumbo 250 External, the Maynard ArchiveXL 5580e, and the Mountain FileSafe External 8000Plus made this grade.

The Pericomp certification process involves evaluating a combination of hardware and software; that's why a company that uses the Mountain drive mechanism with its own proprietary software, for instance, won't necessarily pass the Pericomp tests. The same is true of a system that uses one of the QIC-certified drive mechanisms and even a modified version of the software that typically comes with that drive.

Mechanically and magnetically, the DC-2000 series of minicartridges used by QIC-80 and its variations are identical to each other. They cost about the same as the maximum-capacity DC-2000 media used for QIC-40 drives—about $45 from tape drive makers and $27 on the street.

QIC-80 tape drives are supposed to read tapes made under the QIC-40 standard. QIC-80 simply packs data tighter and on more tracks than QIC-40 (14,700 bits per inch and 28 tracks versus 10,000 bits per inch and 20 tracks), doubling minicartridge capacity to 80MB (with 215-foot tapes) or 120MB (with 307.5-foot tapes). Data compression roughly doubles those figures, hence the ability to get up to 250MB per tape. However, because of data compression vagaries, QIC-80 manufacturers never represent their systems as 250MB drives; instead, they refer to them as 120MB units with data compressed.

The principal appeal of minicartridge backup is its low initial cost coupled with its overall convenience. Compared with minicartridges, floppy disk backup is time-consuming.

Most minicartridge systems allow your backups to extend across several tapes to accommodate disks larger than a single tape can hold, sacrificing only the convenience of unattended operation.

MINICARTRIDGE APPEAL

The principal appeal of minicartridge backup is its low initial cost coupled with its overall convenience. Compared with minicartridges, floppy disk backup is time-consuming, inconvenient, and not that cheap. Floppy disk media cost is about three times as high (at $0.50 per 1.44MB floppy disk, storing 250MB of data comes to about $85, versus $27 for a formatted DC-2000–series minicartridge on the street).

Another competitor to minicartridge backup is the removable hard disk. Both media come as actual hard disks (made by SyQuest) and flexible cartridges such as Iomega's Bernoulli drive. While these systems have the advantage of doubling as primary storage systems because of their quick access times—they take milliseconds to find files instead of tens of seconds—they also yank up backup costs. For instance, the least expensive Bernoulli (the Bernoulli Internal Partner 90) lists for $999, and 90MB cartridges are priced at around $230.

Other technologies are more exotic—or more archaic. You can buy an ancient 9-track open-reel transport that uses half-inch tape; although it's still the best option for moving data between radically different architectures, it's very costly. For example, Qualstar Corp.'s low-end Qualstar Ministreamer Model 1052 lists for $3,200 and packs 130MB per reel (818-882-5822). You can also choose from rewritable or WORM optical disk drives. Even though these drives are gaining in popularity, they're still expensive. Rewritable systems typically cost between $1,800 (for a drive capable of storing 128MB of data) and $6,000 (for 5.25-inch versions accommodating as much as 650MB). WORM drives, which can hold about 1GB of data, are priced at about $1,800 for internal versions and $3,000 for external units.

Serious competition comes where minicartridges can't satisfy backup needs—at huge capacity levels (see the sidebar "Choosing Between QIC-1350 and Helical-Scan Options"). Larger cartridge systems—so-called full-size cartridges based on DC-6000 tapes—cost two to three times as much as minicartridges and hold from 60MB to 1.35GB, although the cost per cartridge is similar to the minicartridge.

At the highest end, you can opt for DAT drives (typically priced at about $5,000) or 8-mm. tape drives, which are gaining popularity among gigabyte-class backup systems. Currently, 8-mm. tape drives are also expensive—about $6,000 to $8,000. However, media costs are low. You can put about 2GB on a DAT cartridge that costs around $11 on the street and 5GB on an 8-mm. cartridge that costs $8, which works out to about one-hundredth of the minicartridge cost per megabyte. (For more information on backup options, see the sidebar "Backup Alternatives: What's Out There.")

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dBFast provides a migration path to Windows for dBASE, Clipper and FoxBase applications. With extensive Windows support applications you can utilize Windows objects such as push buttons and check boxes. **Publisher: Computer Associates BS5543 $349.**

★ACCPAC Simply Accounting for Windows

Ready to computerize your accounting? ACCPAC Simply Accounting contains everything you need to get up and running in a flash. Features: a primer that walks you through basic accounting principles, a real-life tutorial with sample data, and six different, modifiable industry accounts charts.
Publisher: Computer Associates FN0523/5 $129

CA-Cricket Graph 1.3

CA-Cricket Graph is the charting application for scientists, engineers, and business people. It's ideal for anyone who needs to create graphs for reports, presentations, and data analysis.
Publisher: Computer Associates GR1823

$85

FoxPro 2.0

FoxPro increases productivity through its improved user interface. You can operate FoxPro using its pull down menus, or enter commands directly into the Commands Window, or simply use Control key shortcuts. The View Window is the master control display, where you can create databases, open files, browse, establish relations, and set options without programming. Developers can create menu- and Window-oriented custom applications. Users can move and resize the windows as necessary.
Publisher: Fox Software BS4065

$485

The UnMouse

The UnMouse does everything a mouse can—only faster, easier, and in less space. To move the cursor, simply slide your finger over the glass surface. To make a selection merely press down. The UnMouse also serves as an extended keyboard. Tap the large red button and you have a Power Keypad with 16 keys instantly available to execute macros (60 in advanced mode). With its one million touch points the UnMouse also performs as a small graphics tablet. **Manufacturer: Microtouch IN0810**

$165

★Aldus® PhotoStyler™

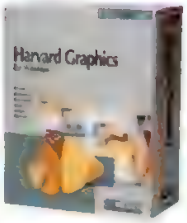
Aldus PhotoStyler is the first complete, professional color image-processing application for the PC running under Microsoft Windows. It gives you the ability to acquire images from a wide range of sources and industry-standard file formats, enhance or modify them for use in publications and presentations, and even create new images from scratch-all in one program. **Publisher: Aldus GR5034 $519.**

★Aldus FreeHand®

Aldus FreeHand combines an elegant interface, powerful features, and superior output quality to give you the easiest-to-use tool for creating simple or sophisticated graphics. From black-and-white laser output to full-color prepress production, Aldus FreeHand is the most comprehensive design and illustration package for Windows.
Publisher: Aldus GR3043/5

$399

★Harvard Graphics® for Windows



The ideal presentation graphics product for the business user. Harvard Graphics for Windows has been built from the ground up to unleash the power of the Windows 3.0 environment and make your presentations come alive. Whether it's keeping your presentation content up to date, analyzing chart data, or changing the presentation's appearance at the last minute, Harvard Graphics for Windows offers a dynamic approach unparalleled in any presentation graphics software program.
Publisher: Software Publishing GR5063/5

$369

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CorelDRAW! 2.0 is the PC graphics software for everyone. It's fun and it's powerful, and the winner of over 40 international first place awards! CorelDRAW! gives you incredible type control, superb drawing power, and stunning special effects in a value-packed program. It comes with over 150 fully scalable outline fonts (which can be converted for use with Adobe Type Manager); over 4000 clipart images and symbols; dozens of fill patterns, dotted and dashed line styles, and Arrowheads; 31 import/export filters; a free Pantone license; and free utility programs - CorelTRACE, WFNBOSS, and Mosaic. Windows 3.0 or OS/2 required. Also available on CD ROM. **CD0220 $445 Publisher: Corel Systems GR0543/5**

$369

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[illegible]

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Publisher:
Okna Corporation
BS3124

$79

OnTime for Windows

OnTime for Windows gives you an indispensable combination of productivity tools: a calendar, an appointment book, a [illegible] pocket secretary, desktop planner, tickler file, and even an alarm clock. It displays your daily schedule on screen, with a choice of [illegible] [illegible] OnTime's tri-foot [illegible] weeks at a glance, is the talk of the industry. [illegible] keyword search. [illegible] important events. Requires Windows 3.0. **Publisher: Campbell Services**
[illegible]

$75

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Winner of 1991 PC Magazine "Editors' Choice," the Byte "Award of Merit," InfoWorld "Buyers Assurance Seal," and InfoWorld's "Top Scoring" Memory Manager. 386MAX 6 is perfect for both the experienced and the novice user. A new graphical interface seemlessly integrates memory management with SmartMemory, a disk cache and a powerful system analyzer. After reliably recovering maximum high DOS memory, 386MAX automatically optimizes and configures your system for the most conventional memory. **Publisher: Qualitas.** Also available: ***BlueMAX* 6 UT1673 $79.** ***386MAX* 6 UT0684**

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EX2020	ATI 8514 Ultra	565
EX2010	VGA Stereo FX	325
Aview		
EX1940	Desktop TV VG1	299
Boca Research		
EX1840	BRAT90 with ØK	115
Brown - Wagh		
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EN0910	Sound Blaster	115
EX1800	Sound Blaster Pro	199
Digital Vision		
EX1195	ComputerEyes Prof. Series	359
EX1610	ComputerEyes Color/RT	529
Media Vision		
CD0320	Multi Media PC Upgrade Kit	829
EX1580	ProAudio Spectrum	259
Persona Technologies		
EX2060	PC Speakers	179
Stac Electronics		
EX1480	Stacker 2.0	85

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	BASF, Sony, Maxell and bulk Fuji	Call
Kensington		
AC0140	Masterpiece Plus	95
LB Innovators		
	Various Colors Wristsaver w/MousePad	21
	Various Colors Wrist Saver	13
	Various Colors Wrist Saver MousePad	13
Targus		
AC2340	Premier Leather Case	169
AC0670	Universal Notebook Case	66

DRIVES/CD ROM

Iomega		
DR2060	Bernoulli 90MB Cartridge	145
DR1970	Bernoulli 90MB Transportable	799
MicroSolutions		
DR1240	backpack 1.4	210
DR1790	backpack 2.8Mb	249
Plus Development		
DR1250	HardCard II XL 105 MB	469
Teac		
DR0910	Teac 3.5 1.44 FD	75

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BN0080/70	Adobe PostScript Cartridge with Type Cartridge 1 or 2	299ea
PR1314	★ATM Plus Pack	125
Canon		
PR1710	Auto Sheet Feeder for BJ-10e	72
PR1500/10	Bubble Jet BJ 10ex	325
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PR2320	GSX-140 Plus Color Printer	339
Epson America, Inc.		
PR2130	EPL 7000 Laser Page Printer	879
IQ Engineering		
PR0610	Super Cartridge 2	299
PR1950	Super Cartridge 3 Pro	299
Pacific Data Products		
PR1120	25 Cartridges in One!	269
PR0910	Pacific 4 Memory w/ 2Mb	145
PR0490	PacificPage w/1 2 4 Plus 2mb	375
Panasonic		
PR2200	KX-P1124i Printer	299
PR2190	KX-P2624 Silent	469

MODEMS & FAX BOARDS

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MM2080	2400 Baud V 42BIS & 9600 Baud S/R Fax	185
Hayes		
FX0020	JT Fax 9600B Int	379
MM2060	OPTIMA 24	159
MM0930	OPTIMA 96 V 32	419
MM0250	Personal Modem 2400 Plus Ext	149
MM0810	Pocket Edition 2400	125
MM0210	Ultra SmartModem 9600 V 32	689
MM0860	Ultra 144 V 32 BIS Ext	849
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FX0060	The Complete Communicator	320
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Zoom Telephonics		
MM0690	HC2400S w/9600 Sendfax Int	95
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3-Com		
NT0060	Ethernet II-Single User	199
Artisoft		
NT0110	Lantastic 2 MBPS Adapter Card	149

INPUT DEVICES

Appoint		
IN2130	MousePen Professional	65
IN2260	Thumbelina	69
Caere		
IN2314	★The Typist Plus Graphics (AT)	389
CH Products		
IN0910	FlightStick with Falcon 2.0	45
Logitech		
IN1070	Scanman 256	269
IN2250	Trackman Portable	99
Marstek		
IN2310	★Color Artist Hand Scan. for Win. 3.0	489
IN1040	M-800 Scanner w/OCR	169
IN2000	★M 800W Scanner w/Image-in	165
IN2070	M-6000CG ColorArtist w/ OCR	399
Microsoft		
IN2150	Ballpoint Mouse	119
IN0890/80	Mouse (bus/ser)	85
IN0275/84	★Mouse w/Windows (bus/ser)	145
MicroTouch Systems		
IN0810	The UnMouse	165
The Complete PC		
IN2110	Complete Page Scanner w/ WordScan OCR Software	569
Z-NIX		
IN1003/5	★SuperMouse II (ser) w/Win 3.0	89

MONITORS

Various		
MT0280	PanaSync C1381 14" VGA Color	369
MT0320	Samtron Super VGA Color	329

ENTERTAINMENT & EDUCATION

Abracadata		
EN2694	Design Your Own Home Architecture Interiors Landscape	49 ea
EN2684	Design Your Own Railroad	35
Broderbund		
EN0734	SimCity	29
ED0184	Where in the USA is Carmen SanDiego	32
Centron		
EN1073/5	Casino Master	39
Entertainment On Line		
EN2014	Lottery Tracker & Wheeler 4.0	29
Microsoft		
EN1473/5	★Entertainment Pack	29
EN0043/5	★Flight Simulator 4.0	38
Personal Training Systems		
ED2323	★Excel beginning Spreadsheets	65ea
ED2253	★Lotus 1 2-3 beginning Spreadsheets	65ea
ED3023	★Word 2.0 beginning Spreadsheets	65ea
Software Marketing		
ED3034	BODYWORKS	49

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PR1594	★Adobe Type Manager	59
GR2094	★TypeAlign	65
GR5144	★Illustrator for Windows	449
Aldus		
GR3043/5	★Aldus FreeHand	399
GR5034	★Aldus PhotoStyler	549
GR2053/5	★PageMaker 4.0	489
GR5013/5	★Persuasion 2.1	330
Arts Software		
GR3074	★FontMonger for Windows	98
Atech		
GR2763/5	★Pubublisher's Powerpak for Windows	44
GR2773/5	Publisher's Powerpak for WordPerfect	44
Berkeley Systems		
GR1994	★After Dark for Windows	29
Broderbund		
GR1564	New Printshop	35
Computer Associates		
GR1823	CA-Cricket Graph 1.3	85
Corel Systems		
GR0543/5	★CorelDRAW! 2.0	369
FontBank		
GR2823	FontBank Type Companion	99
Gold Disk Inc.		
GR3124	★ScreenCraze for Windows	29
Icom Simulations		
GR1654	★Intermission 2.0	32
Micrografx		
GR2833/5	★Windows Draw!	105
Microsoft		
BS2304	★Powerpoint for Windows	315
GR3144	★Microsoft Publisher for Windows	129
New Vision Technology		
GR3174	★Presentation Task Force CGM 4.0	134
Software Publishing		
GR2303/5	Harvard Graphics 3.0	415
GR5063/5	★Harvard Graphics for Windows	369
ZSoft		
GR0634	PC Paintbrush IV Plus	119

CAD PRODUCTS

American Small Business Co.		
CA0023/5	Design CAD 3D 3.1	198
CA0203	Design CAD 2D	175
AutoDesk		
CA0173/5	Autosketch 3.0	146
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CA0074	Generic CADD 5.0	285

BUSINESS

AddStor		
UT2194	SuperStor	85
Artworx		
BS4094	Graftek	95
Ashton Tate		
BS0774	dBASE IV 1.1	485
AutoMap, Inc.		
BS5224	AutoMap	50
Borland International		
BS0214	Paradox 3.5	519
BS3044	Quattro Pro 3.0	319
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BS3584	★OnTime for Windows	75
BS2854	OnTime	45
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UT2064	Central Point Anti-Virus	85
UT2133/5	★PC Tools 7.1	119
Chipsoft		
TX0304	TurboTax 9.0 for DOS	49
Computer Associates		
BS5543	dBFast	349
FN0523/5	★ACCPAC Simply Accounting for Windows	129
DacEasy Inc.		
FN0014	Dac Easy Accounting 4.2	95
FN0024	Dac Easy Bonus Pak 4.2	129
FN0034	Dac Easy Light	40
Datastorm Tech.		
CM0424	PROCOMM PLUS 2.01	65
DCA/Crosstalk Communication		
CM0194	★Crosstalk for Windows	129
CM0284	Crosstalk Communicator	45
CM0034	Crosstalk Mk4 2.0	150
Delrina Technology		
BS2604	★PerFORM PRO 3.0	185
FX0154	★WinFax Pro 2.0	75
Fifth Generation		
UT0724	Direct Access 5.1	65
UT2184	Fastback Plus 3.0	125
Fox Software		
BS0705	Foxbase + Dev. System 2.10	189
BS4065	FoxPro 2.0	485
Gibson Research		
UT0874	Spinrite II 2.0	65
Helix		
BS3154	★NetRoom Single User 2.0	59
Inset Systems		
UT1614	HiJaak 2.1	99
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FN0164	Quicken 5.0	43
FN0564	★Quicken for Windows	35
Lotus		
	All Lotus Upgrades	Call
BS4204	Am. Pro 2.0	299
BS5203/5	Lotus 1 2 3 3.1 Plus	419
BS4073/5	Lotus 1-2 3 Rel. 2.3	339
BS5253/5	★Lotus 1 2 3 for Windows	399
BS3973	Lotus Graph Writer II	335
Microcom		
CM0574	★Carbon Copy for Windows	119
CM0084	Carbon Copy Plus 6.0	115
Microsoft		
OP0113/5	DOS 5.0 Upgrade	59
BS3254	★Excel for Windows 3.0	309
FN0464	★Microsoft Money for Windows	45
BS4103/5	★Office for Windows	485
BS2733/5	★Productivity Pack	39
BS2704	★Project for Windows 1.0	445
BS2253/5	★Windows 3.0	99
BS1954	★Windows Developer's Tool Kit	315
WP0043/5	Word 5.5	209
WP0374	★Word for Windows 2.0	299
BS5324	★Microsoft Works for Windows	129
BS0173/5	Works 2.0	95
Multisoft Corporation		
UT0554	PC-Kwik Power Pak 2.1	75
UT0543/5	Super PC - Kwik 4.1	45
Norton-Lambert		
CM0503/5	★Close-Up 4.0 f/Windows & DOS	119
Okna Corporation		
BS3124	★The DeskTop Set 3.0	79
PC Globe, Inc.		
BS1834	PC Globe 4.0	37
BS1844	PC USA 2.0	35
Peachtree Software		
FN0293/5	Peachtree Complete III 5.0	145
Polaris		
BS2894	★PackRat 4.0	259
Power Up Software		
BS1654	Calendar Creator Plus 4.0	49
Qualitas		
UT0684	386MAX 6	65
Quarterdeck Office System		
BS1043/5	DESQview 386 2.4	129
EX1103/5	QEMM 386 6.0	61
Que Software		
WP0544	RightWriter 4.0	52
Reference Software		
WP0514	★Grammatik Windows	55
Softstream		
TX0224	TaxTutor Plus	62
BN0210	TaxTutor Plus/TurboTax 9.0 for DOS Bundle	99
Spinnaker Software		
BS1923/5	BetterWorking Eight-In-One	32
BS3604	★PFS Window Works	125
Symantec		
UT2273/5	Norton AntiVirus 2.0	85
UT2183/5	★Norton Desktop for Windows	99
UT2313/5	Norton Util. Advanced 6.01	115
UT2153	★Norton Backup Windows/DOS	85
CM0173/5	PC Anywhere 4.5 Host and Remote	119
BS4013/5	Q&A 4.0	255
BS3723/5	★On Target 1.0	255
Teleware		
FN0414	★M.Y.O.B for Windows	135
Timeslips		
BS5953/5	★TimeSheet Professional for Windows	129
BS0133/5	Timeslips III 4.0	189
Traveling Software		
UT2074	LapLink Pro	109
Trion		
CM0544	CO/Session	109
WordPerfect Corp.		
WP0363/5	WordPerfect 5.1	249
WP1653/5	★WordPerfect 5.1 for Windows	295
WordStar U.S.A.		
WP1604	★Correct Grammar for Windows	65
WP1614	★WordStar for Windows	279
XTree Company		
UT1874	XTree Gold 2.5	99

LANGUAGES

Borland International		
LN1654	Borland C++ 2.0 Prof.	329
LN1664	★Object Vision for Windows	105
LN1673	Turbo C++ 2nd Edition 1.0	69
LN0463/5	Turbo C++ for Windows	105
Microsoft		
LN0085	QuickBasic 4.5	65
LN0043/5	QuickC 2.5	65

OPTIMA 24

$159

Manufacturer: Hayes MM2060

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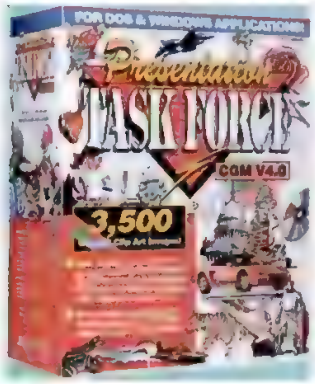


★Presentation Task Force CGM clip art 4.0

Now you can own the clip art PC Magazine recently called..."The best CGM clip art package for overall quality and usability." Presentation Task Force 4.0 is the only clip art product to feature over 3,500 high quality, color illustrations in one value packed, comprehensive volume! Use PTF clip art to enhance presentations, newsletters, and spreadsheets created with over 60 leading DOS and Windows applications, including: CorelDraw!, Designer, Harvard Graphics, Microsoft Publisher, PageMaker, Persuasion, PowerPoint, Quattro Pro, Ventura Publisher, Word for Windows, WordPerfect, and many more! PTF 4.0 contains people, animals, business symbols, medical illustrations, holidays, sports, military, and environment-related images. **Publisher: New Vision Technologies, Inc.** GR3174

$134

Graftek

Graftek analyzes and produces graphs from your data. It performs calculus, statistics, frequency analysis (FFT), transformations and extensive curve fitting. It's library of math and trig functions allows you to define and plot your own functions. Its analysis capabilities include area under a curve, zeros, minima and maxima, inflections, standard deviation, sum, mean, variance, correlation coefficient and more. Graftek has an easy-to-use, full featured Help structure. Requires graphics card and a mouse. **Publisher: Artworx** RS4094

$95

Design Your Own Home: Architecture, Interiors, Landscape

With Architecture, you can draw professional-quality floor plans, side view building plans and structural details in record time, trimming home improvement costs. Architecture automatically calculates all distances, areas, and angles. Interiors is a beautifully simple approach to a more beautiful home. Arrange and rearrange furnishings in seconds. Explore subtle color schemes and variations. Switch from top views to side views. Landscape is easy to use and can help prevent costly mistakes. Position flowers, shrubs, trees, walks, steps, fences, etc. for that look you want. Dozens of sample plans are included with each version. Modify them or create your own. **Publisher: Abracadata** *Architecture* EN2694
Interiors EN2704
Landscape EN2714

$49ea

★Adobe Illustrator 4.0

Adobe Illustrator 4.0 for Windows provides a professional illustration solution for the PC environment. This new version of the program allows graphic artists, designers and desktop publishers to create professional-quality illustration and design. This value packed program includes Adobe Type Manager software (ATM), 40 Adobe Type 1 type faces, the Adobe TypeAlign type manipulation program, Adobe Separator color separation software and a generous selection of Adobe patterns, textures symbols, and borders. Other features include: Edit in preview, On-screen text, Resizable toolbox plus enter and edit text directly on screen. With Adobe Illustrator, users can now freely exchange files between Windows, Macintosh and NeXT desktop platforms. **Publisher: Adobe Systems** GR5144

$449

Marstek ColorArtist Hand Scanner for DOS

The ColorArtist combines color and true gray scale scanning into one affordable scanner. Scan color photographs in up to 262,144 colors or black and white photographs with 64 shades of gray. Switch to halftone mode for line art or OCR. The package includes the M6000OG scanner, interface card, Rainbow Paint editing software and Perceive Personal OCR software. **Manufacturer: Marstek**

Also available: ***Marstek ColorArtist Hand Scanner for Windows 3.0.*** For Microsoft Windows 3.0 users, this package includes the M6000OG scanner, interface card, Picture Publisher 3.0 LE software and Perceive Personal OCR software. **Manufacturer: Marstek** IN2310 $489.

Marstek Colorartist Hand scanner for DOS IN2070

$399

★TimeSheet Professional® for Windows

Streamline management chores and take the burden out of time and expense tracking. TimeSheet Professional is an excellent product to track time and expenses for projects and clients. It is designed for use by engineers, researchers, MIS professionals, government agencies, contractors—any professional who can increase productivity by tracking time and expenses. Familiar Windows icons, pull down menues and dialog boxes make TimeSheet Professional easy to use and quick to learn. The unique electronic spreadsheet design provides a week-at-a-glance view of all your projects and tasks with the time spent for each day as well as weekly totals. **Publisher: TimeSlips** RS5953/5

$129

★Crosstalk® for Windows

InfoWorld named it "Product of the Year" and Software Digest called it the "best of the graphical communications packages." It's Crosstalk for Windows, a full-featured program including VT 220/VT320 emulsion, ZMODEM file transfer, high-speed modem support and modem sharing on LANs. Using Windows multi-tasking, you can work on other applications while Crosstalk for Windows is establishing connections, sending and receiving files - all in the background, while using only 150K RAM!

Publisher: DCA/Crosstalk CM0194

$129

CIRCLE 225 ON READER SERVICE CARD

MANY COMPANIES, FEWER MAKERS

The number of manufacturers of minicartridge tape drive mechanisms is smaller than the number of vendors who are selling systems based on those drives. While there are 13 products in this review, only Archive (via its Ardat division), Colorado Memory Systems, CORE, Everex, Irwin Magnetics (another Archive division), Mountain, Summit, and Wangtek count themselves among the drive manufacturers. Note that the product names can confuse the sometimes intimate relationships between drive vendors. For example, Maynard is the retail arm of Archive, and Irwin is now a division of Maynard. Summit makes Mountain's drives, and both Summit and Mountain are owned by Nakamichi.

The most significant differences among the minicartridge backup systems examined here often appear in aspects other than the drives themselves—specifically, the software and the interface. Software determines convenience in everyday use, and the interface determines installation convenience.

For now, the QIC-80 standard exploits a floppy disk interface operating at either 500 kilobits per second or 1 megabit per second (the rate of 2.88MB extra-density floppy disk drives). All products reviewed here used a floppy disk interface of some kind; the Micro Solutions Backpack Tape Drive, however, interacts with that interface through the parallel port.

Some drives—mostly the low-cost internal units—plug directly into a spare floppy disk drive connector or use low-cost cables to link with your existing floppy disk drive controller. The external units we review here either use a ribbon cable connector alone or attach the connector to an expansion board. These interface boards usually just pass along the signals of your floppy disk controller, adding only a wire and a bit of internal confusion. Other units offer controllers, which provide their own dedicated electronics—still based on floppy disk controller chips—and eliminate the need to tangle with your floppy disk cables. (In our reviews, we

CHOOSING BETWEEN QIC-1350 AND HELICAL-SCAN OPTIONS

If you have more data to back up than minicartridge-based tape drives can accommodate, it may be time to investigate higher-end options, such as QIC-1350 and helical-scan tape drives.

by Winn L. Rosch

Although minicartridge technology carries the lion's share of the low-end and midrange backup market, the high end will be home to intense competition between two technologies: full-size tape cartridges (DC-6000) for the high-capacity QIC-1350 standard and helical-scan tape, which is available in both 8-millimeter videotape and 4-mm. digital audio tape (DAT) versions.

For now, most users who have more than a few hundred megabytes to back up will be choosing between those two technologies, but devices such as 9-track, read/write optical, and WORM (write once, read many) drives also get a piece of the high-end market share. However, 9-track tape is basically a high-priced grandfather technology still used for data exchange across virtually any two systems, such as mini to mainframe or even to PCs; read/write optical and WORM drives are still infant technologies carrying high price tags and offering nearly on-line speed for data access.

ON THE DAT HAND

Developed and patented in Japan, DAT is said to be better suited to computer storage because it was originally created as a high-capacity digital medium. DAT has been capable of holding up to 1.3GB of uncompressed data from its inception, and units with 2GB (uncompressed) capacity have recently began shipping.

DAT technology has two important strengths: access speed and capacity. The 4-mm. DAT medium was designed for rapid access to information, hence a file can be located in about 15 seconds (compared with 30 seconds for a DC-6000 cartridge). This speed is generally more important for restorations than it is for backups.

DAT tape is packed into 3-inch by 2-inch cassettes, about 3/8 inch thick. You can buy tapes in either 60- or 90-meter lengths, and they list for about $30 and $60, respectively. The shorter DAT cassettes store 1.35GB at 1,869 tracks per inch, and the longer ones can store 2GB of data.

When installed internally, DAT drives will fit into 3.5-inch drive bays. The competing QIC-1350 and 8-mm. drives require 5.25-inch bays.

8-MM. OFFERINGS

For very high-capacity systems, a similar helical-scan technology, 8-mm. tape, currently offers up to 5GB of storage per cartridge without compression (up to 10GB with compression). (By the time you read this, Exabyte should have introduced its EXB-8500c CST, which reportedly will store up to 25GB of compressed data using IBM's IDRC compression algorithm.) Eight-mm. tape was first conceived by Sony as a video system and later adapted to digital storage. Note that although 8-mm. tape cartridges look like those used for the newer videocassette recorders, the cartridges used for those machines are not recommended for reliable data storage.

As the name implies, 8-mm. tape uses tape 8 mm. wide, and 112 meters long. It comes packaged in 3.75-inch by 2.5-inch cassettes about half an inch thick; these cassettes list for approximately $30.

THE QIC PERSPECTIVE

One argument in favor of helical-scan tape is that 1GB or higher storage capacities are not promised for future delivery: They are available today. Quarter-inch tape drives using the DC-6000 medium have been packing

differentiate between the connection methods by using the term *interface* only in conjunction with supplied ribbon cable connectors or the boards they are attached to.) The Micro Solutions Backpack connection differs from the other units; it simply plugs into your PC's printer port (LPT1 or LPT2), making it ideal for use with laptops. That connection method wins hands down on the convenience front.

Things aren't always that simple, though. On our Compaq 386/25e test-bed, the interface connector that is identical in both the Tecmar and Wangtek systems is too short to reach the motherboard-based floppy disk drive controller. We had similar problems working around interface connectors that were supplied with the Tallgrass FS250e and the Maynard system. While the real item at fault here is the poor placement of Compaq's floppy disk drive connector, anyone owning a similarly constructed PC should keep this in mind.

In the future, IDE interfaces promise to make an impact on the minicartridge tape backup market (see the sidebar "New Tape Backup Interface Solutions"). When you read this, both Mountain and Summit will be shipping their IDE-based systems. One of the benefits of the IDE approach is increased transfer speed (remember that software carries weight here, too).

REVVING UP

Six manufacturers—Colorado, Irwin, Mountain, Summit, Tecmar, and Wangtek—offer accelerated controllers as options; typically, these controllers cost from about $200 to $300. The Tallgrass FS300e tape drive includes an accelerated controller in its standard configuration. In contrast to the 500-kilobit-per-second rate supported by standard controllers or interfaces, these accelerated controllers support a 1-megabit-per-second transfer rate.

On our tests of units in their standard configurations with verification on, those systems that included accelerated controllers (the Tallgrass FS300e and the Irwin AccuTrak Plus) provided some of

150MB, 320MB, and 525MB per cartridge for some time, but quarter-inch drives following the QIC-1350 standard for 1.35GB capacity (with transfer rates of 180K to 200K per second) were not on the market at press time, though they should be shipping by the time you read this. And while 2.1GB drives, which will follow the QIC-2100 standard, have been announced, no such products are currently shipping.

However, QIC is catching up fast. Capacities of 20GB (uncompressed) per DC-6000 tape are expected by 1993, and 40GB capacity or more per cartridge is expected by 1995. (The same advances that allow these increases will push minicartridge storage up to 6GB per tape in 1995.)

How can DC-6000 cartridges manage this leap in capacities? It's simple; quarter-inch drives have more capacity potential than DAT or 8-mm. tape because the cartridges are bigger. The QIC-1350 uses DC-6000 cartridges (priced at about $25 to $30 each) that are about 5/8 inch thick and measure 6 inches by 4 inches. A full-size quarter-inch cartridge holds about 2,280 square inches of magnetic medium; DAT holds about 533 square inches, and 8-mm. tape holds about 1,365 square inches.

The helical-scan tape drives achieve their currently higher capacities with higher areal densities: 114 megabits per square inch for DAT compared with 5.4 megabits per square inch for a 1.35GB DC-6000 cartridge. Adding better tape and higher areal densities could allow quarter-inch systems to achieve 60GB per cartridge without compression. To achieve that amount of storage, helical-scan systems would require a more fundamental change—possibly a new cassette style.

Quarter-inch cartridge drives are simpler mechanically than helical-scan tape drives, although the cartridges themselves are more complex mechanically. A helical-scan tape drive is based on a rapidly spinning read/write head and a complete tape-transport mechanism involving a capstan motor and reel drive mechanism. Quarter-inch cartridges only move their heads linearly (vertically) to define tape tracks; the tape drive mechanism consists of a single shaft that moves the tape. There's less that can go wrong in a quarter-inch tape drive than in a helical-scan drive, although a helical-scan tape drive can tolerate more tape variations.

Bare DAT drives (for example, the Ardat Python or WangDAT Model 3000) start at about $1,500, but complete subsystems from companies like Maynard Electronics are priced in the $5,000 to $6,000 range. Bare 8-mm. drives with 2.5GB capacities, like the Exabyte EXB-8200, start at $1,640, but complete 8-mm. helical-scan systems capable of storing 5GB of uncompressed data typically cost between $6,000 and $8,000. Although the cost per tape for 8-mm. helical-scan and quarter-inch systems is similar, helical-scan cassettes have traditionally offered a lower cost per megabyte (or gigabyte).

Full-size quarter-inch cartridge drives are relatively inexpensive if you want 320MB to 525MB capacities—often under $1,000. Some complete DC-6000 systems in this range are available on the street for $600. However, you should expect the prices for QIC-1350 tape drives to be more comparable with 4-mm. DAT prices—about $5,000.

All three alternatives—DAT, 8-mm. helical-scan tape, and QIC-1350—obviously have a place in the market. The one you choose will depend on the minimum storage requirements you need (1.3GB, 2GB, or 5GB) and how long you can wait for a system that fulfills those needs. At press time, only DAT and 8-mm. tape drives with capacities of 2GB or more of uncompressed data were available. Your decision will also depend on what you think you might require in the way of future storage and whether you need backward compatibility with existing backup media. If this is important to you, you may be best off waiting for—and staying with—QIC tape drives. ■

BACKUP ALTERNATIVES: WHAT'S OUT THERE

by Oliver Rist

Following is a rundown of current data backup solutions, including who their intended users are, what they provide in terms of speed and capacity, and how much they cost. Match up your backup requirements with the capabilities offered by these various backup options to make the best choice.

One factor you may want to consider when making your decision is how some of these backup solutions will fare in the marketplace in the next five years. Having an idea of where the marketplace is likely to be headed over the long term can help you choose a solution that will be available to meet your needs now and in the future. We report projected U.S. sales up to 1996 for the most viable backup options. The data for 1991 sales and projected future sales was provided by Freeman Associates, a consulting firm in Santa Barbara, California.

■ D/CAS data cassettes

Only TEAC Corp. and Y.E. Data manufacturer the necessary drive, but end users can purchase standalone kits from numerous OEM vendors (including MicroNet Technology, CMS, and LiCIE). Until last year, data cassettes had a bleak future, with only a 160MB maximum capacity. Then TEAC introduced a new drive called the MT-2ST/F50 that boasted 600MB and a data-transfer rate up to 242K per second through its standard SCSI-2 interface. With interface and software, the drive has an end-user price around $2,000. Media costs are about $40. Though some say D/CAS will soon run its course (see accompanying graph), TEAC has other ideas. With the new 600MB drive, 2.5GB cassettes predicted for 1993, and 10GB cassettes expected by 1995, D/CAS may become a high-end backup solution for the nineties.

■ Quarter-inch tape (DC-2000 minicartridges)

Using the new QIC-80 standard (or competing formats, like Irwin Magnetic Systems'), quarter-inch tape drives (for DC-2000 minicartridges) represent the fastest-growing low-end and midrange backup solution. Prices range from $350 to $1,195 (depending on form factor and whether the drive is internal or external). Capacity usually tops out around 250MB with data compression and extended-length tape. The media typically sells for about $30.

QIC-40 drives (or those using comparable technologies) use an older drive technology but similar DC-2000–series cartridges. However, these systems offer only 40MB capacity (120MB with data compression and extended-length tape). Internal drives cost around $250 list price; external drives will typically add about $150 to the cost. As with QIC-80 systems, the interfaces are generally floppy disk drive controllers. Most of the major QIC-80 tape drive manufacturers still make QIC-40 products, although they're really useful only for single-user backup.

Early this year Summit Memory Systems, Mountain Network Solutions, and Irwin Magnetic Systems all announced tape drives based on IDE or SCSI interfaces. Using the IDE interface and data compression, the Summit and Mountain drives can achieve proprietary data capacities up to 305MB and throughput rates around 10MB per minute. Irwin's SCSI-2 interface allows a data-transfer rate of 13MB per minute. With data compression enabled, the Irwin drive can handle 650MB of data, which can make this system a contender even in the higher end.

■ 4-mm. DAT and 8-mm. helical scan

8-mm. helical-scan drives are based on 8-mm. videotapes and are sold by numerous OEM vendors; they are all also based on an Exabyte design. The EXB-8200 8-mm. Cartridge Tape Subsystem was capable of 2.5GB (uncompressed) capacity, while Exabyte's new EXB-8500 can handle 5GB uncompressed data (10GB compressed) at a 500-kilobit-per-second transfer rate. Drives can cost as much as $6,000 for an internal drive and $8,000 for an external drive, with media costs around $30.

A new drive from Exabyte, the EXB-8500c CTS, will reportedly be able to handle up to 25GB of compressed data (5GB uncompressed); the product is expected to ship in the second quarter of this year.

4-mm. DAT helical-scan drives command up to 2GB capacities (uncompressed). Drives manufactured by Archive Corp., GigaTrend, Hewlett-Packard Co., Sony Corp. of America, WangDAT, and Wangtek generally cost between $5,000 and $6,000, with media cartridges running $30 to $60. With data compression, these drives can reach a 4GB capacity and maintain an 11MB-per-minute streamed transfer rate. Though some industry analysts have stated that DAT has topped out at 2.3GB (with 120-meter tapes), vendors are expecting a 3GB (90-meter and uncompressed) DAT drive by late 1993.

■ Quarter-inch tape (DC-6000 minicartridges)

This versatile format can address data storage needs anywhere from 60MB to 1.35GB, using the new high-capacity QIC-1350 standard, which will be available this spring. (2.1GB QIC drives have been announced, but no ship date has been set.) Prices for the lower-capacity DC-6000 drives are around $1,000, though the new QIC-1350 drives will be priced somewhere around $5,000. QIC-1350 drives compete directly with 4-mm. DAT and 8-mm. helical-scan drives (both of which currently offer greater capacities). These drives generally employ a SCSI interface. Drive vendors include Archive, Tandberg Data, and Wangtek.

The primary advantages of QIC systems in general are that they have been around for a long time and are supposed to be backward-compatible. If, for example, you've been using QIC-525 DC-6000–based drives for some time, it makes sense to upgrade to a QIC-1350 drive, which should be able to read your old tapes rather than forcing you to switch technologies and start from scratch.

■ **Optical: WORM and rewriteable drives**
Write once, read many (WORM) drives are capable of storing from 600MB to nearly 1GB of data, making them suitable for high-end needs. They cost from $1,800 to $3,000 (depending on their maximum capacity and whether they're internal or external) and can record data once, after which it cannot be overwritten. This has its downside for many backup needs but makes them useful for data security or document imaging.

Rewritable/erasable magneto-optical (MO) drives cost from $1,800 to $6,000 depending on whether they are 3.5-inch or 5.25-inch, since this also influences data capacity. 5.25-inch drives can generally store 650MB; the newer 3.5-inch drives provide capacities of 128MB, making them better low-end to midrange options. These systems usually use SCSI or proprietary interfaces.

Even though MO drives are an expensive backup solution (cartridges cost between $200 and $500), they can access files in milliseconds, and you can read the files directly from the MO drives instead of having to download to another hard disk as you must with tape. In other words, like a Bernoulli drive, an MO drive can double as primary storage. Ricoh Corp., Sony, and Maxoptix Corp. are among the drive mechanism manufacturers.

As reflected in the graph, analysts agree that the future of rewriteable technology lies with the multifunction drive—a drive that incorporates the best features of WORM and rewritable drives. Presently, HP and Sony, Pioneer Communications of America, and Panasonic Communications & Systems Co. each represent one corner in a vendor triangle trying to establish the first big stake in the multifunction market.

■ **VHS tape**
Cheap ($19.20), high-capacity (14.5GB uncompressed) media cartridges are offset here by very expensive drives ($33,000 to $45,000 for a complete package). Running off a SCSI-1 interface at a 2MB-per-second transfer rate, these drives are targeted mainly at the mini and mainframe computer markets but are entirely compatible with PCs. The most glaring disadvantage (perhaps reflected by the low projected sales) is drive price. The single manufacturer is Metrum Information Storage.

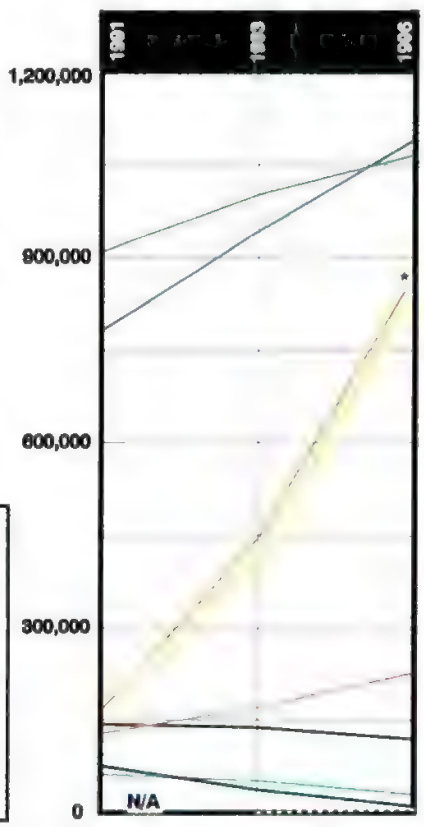
■ **9-track tape**
An older technology, 9-track open-reel transport, uses half-inch tape. This medium is still the best option for moving data between radically different architectures; low-end products start at over $3,000 and have data capacities only around 150MB per reel. Their other disadvantage is the storage requirements for loaded tape reels: 1 terabyte of data could require around 250 cubic feet of physical storage space. Manufacturers include Cipher Data products, M4 Data, and Qualstar Corp.

■ **Removable hard disks and cartridges**
Iomega's removable cartridge drives and SyQuest's removable hard disks are still the best known. Though these can be used as backup devices, they are generally expensive. One SyQuest removable 88MB hard disk costs $750, although Micro Solutions Computer Products' 100MB removable hard disk costs $600. The external 90MB Bernoulli drive costs $1,149, its controller costs $265, and a single 90MB cartridge costs $229.

What these products do offer is excellent 19-ms. access time, which is good enough for you to use them as both backup and primary storage devices.

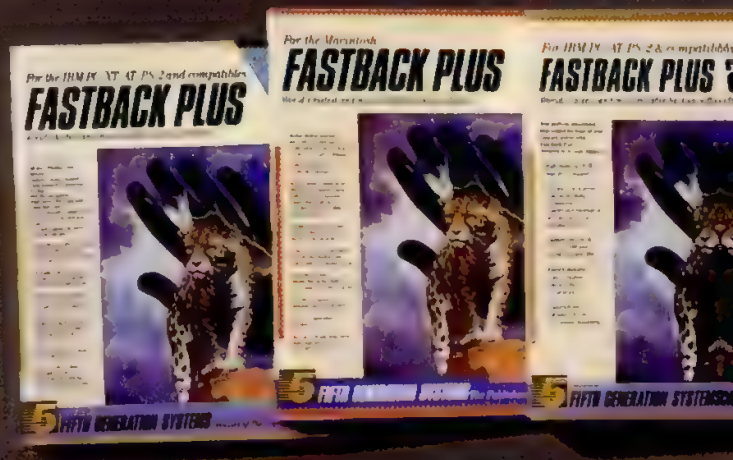
■ **21MB 3.5-inch Floptical drives**
These drives are manufactured by Insite Peripherals with standalone systems sold by Liberty Systems, Peripheral Land, and Prima Storage Solutions (for around $700 to $750). Floptical drives manage 21MB of storage on a single 3.5-inch floppy disk via an optical-servo system. Drives are reportedly backward-compatible with all of the old 3.5-inch floppy disk drive standards. The drives contain ECC, but interfaces are only SCSI-1. With media costs at $22.50 (Maxwell Corp. of America is a major vendor in this arena), Floptical drives could make an efficient single-user backup solution.

■ **2MB floppy disks**
A barely related topic when talking about backing up 80MB or more of data, floppy disks are still used by single-user systems with hard disks of 40MB or smaller, primarily because they require no substantial hardware investment. Major media makers include: 3M Corp., Maxell Corp. of America, and Sony Corp. of America. ■



*** 1996 projected sales are for multifunction drives only.**
N/A—Not applicable: The exact figure for 1991 VHS drive sales is not available. It is, however, under 500 units.

Backup. For people who don't.



Everyone who uses a PC ought to back up regularly. But most people don't back up at all.

In fact, if the people you work with are like those working in most places we know, about the only way their data is going to get backed up is if it happens without them.

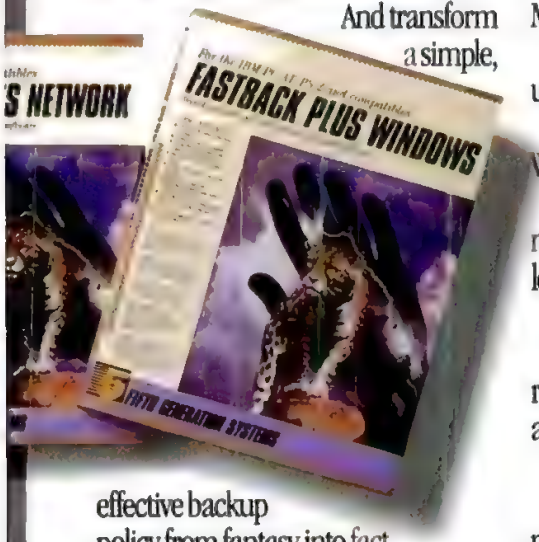
Guess what?

Now it can.

Now you can set up fully automatic, unattended backups for every PC in the house – DOS,* Windows,* Novell* network servers, even Macintosh.*

What's more, you can easily customize the nature and timing of each one to suit *your* specifications.

And transform a simple, effective backup policy from fantasy into fact.



All you need is Fastback Plus.

The world's most popular backup software comes complete with a backup policy of its own – in the form of pre-designed scheduling templates*– that you can adapt with our unique Macro Editor.

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What makes our Macro Editor unique?

It uses plain English commands. Which means you can actually use it.

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That's right. You can actually restore a Mac file directly onto a PC, and vice versa.

Nobody else can do that.

But then, nobody else can back up more than 3MB per minute on an AT. Or up to 10MB per minute on a '386.

No other Windows, Mac or Network backup program can run fast enough to see our tail lights.

And nobody else comes close to our level of reliability.

You can destroy as much as 11% of the data on a diskette and Fastback Plus will recover every last byte, error-free.

Unbelievable?

That's what the people at *InfoWorld* thought.

So they "scratched both disks with the point of a knife to simulate accidental damage" and found, to their astonishment, that Fastback Plus "was 100% successful at restoring all the [damaged] files."

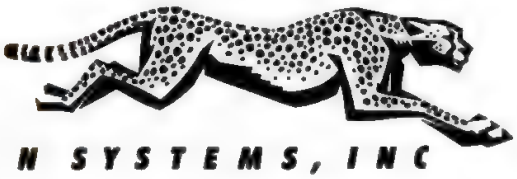
Still unsatisfied, they "ran the test several more times, increasing the severity of damage until we began to fear for our disk drives, but we were unable to generate a single byte of unrecoverable data."

We wouldn't recommend trying this test yourself. But if you insist, you'll be glad to know that Fastback Plus is backed up by our vaunted 24-hour toll-free technical support and a one-year money-back guarantee.

There's more. So pick up the phone. Dial **1-800-677-1848.**

And tell everyone to stand back.

*Scheduling templates included in DOS, Windows and Network versions



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the fastest Full Disk Backup and Directory Backup times. When tested with verification off, these systems' backup rates speeded up significantly, but their Full Disk Restore and Directory Restore times did not change much from those posted with verification on. Among the units that offered accelerated controllers as options, there was generally little difference between the restore times they posted on our standard-configuration tests and the scores they obtained with the accelerator installed and verification turned off, but again, the backup times decreased noticeably.

THE SOFTWARE FACTOR

Minicartridge backup software determines what you can do with the tape drive and how you do it. Most of the vendors still offer software only for the character-based DOS environment, although Irwin's system is packaged with both DOS and Microsoft Windows versions of its *EzTape* software; Summit and Wangtek include *Central Point Backup* for both environments as well.

All of the systems now give you menu control and some means of automating your regular backup procedure—for example, a batch-mode or command-driven option—and the software allows unattended backups. All of the minicartridge systems reviewed here offer file-by-file backups, but fewer give you the option of image backups. In an image backup, the tape makes an identical copy of the disk, including any bad sectors. Unlike in days gone by, however, image backups seem to offer no speed advantage and may pose penalties. PC Magazine Labs recommends that you make file-by-file backups unless you have a specific, overriding reason to do otherwise. Still, for those who want to do image backups, buying a system such as CORE's, Mountain's, or Tecmar's, which all include that capability, is essential.

Most of the software packages accompanying these systems also allow for normal housekeeping, including formatting new tapes (sometimes called initializing or servo-writing). In theory, you'd want to avoid this process because it's very time-consuming, requiring about 2 hours for full tape capacity. Commercially preformatted tapes are widely available for little more cost than unformatted tapes—about $3 extra. In testing, however, the Alloy, the Everex, the Summit, and the Tallgrass FS300e experienced restoration difficulties with preformatted tapes, but these problems vanished when tapes were formatted in the drive used for the backup. The Wangtek E3080PK also produced errors when using a preformatted tape, but we were unable to reformat the tape in that drive; using *Central Point Backup*, the system continuously hung after going through a format previous to

NEW TAPE BACKUP INTERFACE SOLUTIONS

by Oliver Rist

Early this year Irwin Magnetic Systems, Mountain Network Solutions, and Summit Memory Systems announced DC-2000–based minicartridge tape drives with a twist. The Mountain and Summit IDE tape drives, which shipped too late to be included in this review, fall within the QIC-80 definition but are actually based on an IDE interface rather than the slower floppy disk interface for which the QIC-80 scheme was originally written. Irwin, as usual, uses its own proprietary embedded-servo format, and in the tradition of full-size DC-6000 tape backup, uses a SCSI interface.

Though the $695 Summit Express SE305 and the $895 Mountain 8500 can conform to the QIC-80 standard—storing up to 250MB of compressed data using that format and even being able to read backward to QIC-40 tapes—they do so via proprietary IDE interfaces. Using their proprietary formats, they can store up to 305MB of compressed data.

Using vendor-supplied code, the tape drives can plug into your existing IDE hard disk interface or into an IDE controller card, which the manufacturer will supply. So far, software supplied with the tape drive is proprietary, but both Mountain and Summit are reportedly working on a deal with Central Point Software.

IDE is the result of PC clone manufacturers' efforts to define a slot-free hard disk interface—for easy placement on the system board. The present implementation has reduced costs substantially from older interface schemes (such as ESDI) and increased subsystem performance. IDE is capable of a burst data rate of 5.5MB per second (actual tape data-transfer times for the new Mountain and Summit units are around 10MB per minute), which approaches SCSI drive performance.

While Pericomp has not tested either of these tape drives for QIC-80 compatibility, Mountain and Summit feel sure that they will be certified when they are tested. Currently, both tape drives are available only in internal versions but can be configured as either 5.25-inch or 3.5-inch half-height systems.

MARCHING TO ITS OWN DRUMMER

Like all Irwin products, the new $1,095 (internal) and $1,349 (external) versions of the Irwin AccuTrak 2320 do not adhere to QIC standards. Unlike any of the products in the main review (including the Irwin AccuTrak Plus A250E), the AccuTrak 2320 works off a standard SCSI-2 interface. The SCSI-2 enhancement allows a speedy data-transfer rate of 13MB per minute.

The AccuTrak 2320 tape drive also considerably ups the ante for minicartridge capacities. Using a new minicartridge developed by 3M, the DC-2320 (a 900-oersted medium based on Super VHS tape), the AccuTrak 2320 can pack 320MB of data onto a cartridge without compression. Though the DC-2320 is the only cartridge the AccuTrak 2320 can write to, it offers backward compatibility with the AccuTrak 320, 120, 80, 60, and 40. Using an optional $249 2:1 hardware data compression add-in module, you can pack up to 650MB of compressed data onto a tape.

The Irwin unit ships with the same well-designed *EzTape* software that comes with the Irwin AccuTrak Plus A250E. The internal system is packaged in a 3.5-inch form factor but can be configured for use in 5.25-inch tape drives. ■

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FEATURES	Hewlett-Packard LaserJet III	Okidata OL830	Texas Instruments MicroLaser Turbo	NEC Silentwriter Model 95
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LaserJet III Emulation (PCL5)	Yes	No	No	**Yes**
Automatic Emulation Switching	No	Yes	Yes	**Yes**
Enhanced Resolution Technology	Yes	No	No	**Yes**
Automatic Interface Monitoring	No	No	No	**Yes**
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backing up. The Maynard ArchiveXL refused to restore from one preformatted tape, but the problem disappeared when backup verification was switched on.

These problems are troubling because none of the systems warned that a particular backup was flawed until we actually tried to restore; that means you could be left depending on an unusable backup. For safety's sake, and for your peace of mind, you'll probably want to format tapes yourself (that's where the Mountain drive's ability to format on the fly comes in handy) and verify backups before you rely on them. Fortunately, most drives allow you to erase a tape—a quick process—so you don't have to spend hours reformatting an entire tape to recycle it. Only CORE's software did not provide direct methods of erasing a cartridge.

REVIEW CRITERIA

For this review, we required systems to be external minicartridge tape drives that conform to the QIC-80 standard or offer the same minicartridge capacity as the QIC-80 standard (like the Irwin AccuTrak Plus A250E). Some of the reviewed QIC-80–compatible units with accelerators also offer proprietary modes that slightly increase data storage to about 300MB with compression enabled. The Summit Express SE250 Tape Backup is an internal unit, but it was reviewed because Summit does not offer an external version.

We asked companies to send us their standard configurations (which could include an accelerator card) and optional accelerated controllers where available. Irwin offers a standard 500-kilobit-per-second controller—required if you don't use the accelerated offering we tested for

EDITORS' CHOICE

■ **Colorado Memory Systems Jumbo 250 External**

The Colorado Memory Systems Jumbo 250 External, from Colorado Memory Systems Inc., is the winner in this roundup of DC-2000 minicartridge tape drives. The reasons are numerous, and chief among them is Colorado's low price—$509.95 for the external offering (add $40 for a preformatted tape). In an already price-conscious market where the average cost of a ready-to-run external system hovers around $700, the $509.95 list price is particularly noteworthy.

The internal Jumbo 250 system is the base upon which the external system is built. The internal unit sells for a mere $350 list price, which is less than the cost of most of the other vendors' internal tape drives. Expect to find it on the street for as little as $250. If you have an extra half-height drive bay available (either 3.5-inch or 5.25-inch), this is a very attractive option. Colorado's one-size-fits-all approach offers flexibility; with the ability to build on the basic system, you can suit your changing needs. Simply add the $159.95 external chassis and pop the base unit into it (the well-illustrated manual provides excellent guidance) and you've freed up a drive bay for that CD-ROM drive or second hard disk you've been wanting.

The Jumbo 250 External, one of the few tape drive mechanisms certified by the QIC committee's testing facility, is also a competitive performer. On PC Magazine Labs' standard-configuration tests (with verification enabled), it provided solid, midlevel performance. Couple the Jumbo 250 External with the optional $299.95 TC-15 accelerated controller, turn off verification, and watch it fly. In this mode, it was the fastest performer of all the accelerator-equipped competitors.

The versatile *Jumbo Tape* software offers both a menu-driven and a command line interface, and all of the capabilities you'll need for backing up and restoring; its menu choices could make some operations clearer, but there is no lack of features. The company also reports that a Microsoft Windows version is on the way.

If an excellent price, easy operation, and flexibility are what you want in your tape drive, then Colorado Memory Systems is the place to go.

OTHER OPTIONS

If compatibility with the QIC-80 standard is not of utmost importance to you, then the Irwin AccuTrak Plus A250E offers an excellent combination of price and performance. One point in its favor is that it's practically a standard unto itself, with a 40 percent market share. Other welcome features include the simple-to-use *EzTape* software (both DOS and Microsoft Windows versions are included in the package), a generous two-year warranty, and an attractive price: $668 with the standard controller, which we did not review, and $778 with the accelerated controller we tested. (When coupled with accelerated controllers, some of the competition in this review listed for almost $1,200.)

The AccuTrak's performance on our standard-configuration tests was exemplary; you can probably chalk that up to Irwin's proprietary embedded-servo format, but the presence of the accelerator card may also have had something to do with that. One note of caution in this rosy picture, though, is Irwin's recent business troubles: The company cut its staff by 55 percent as its parent company, Archive, folded Irwin's operations into other divisions. Aside from this, the AccuTrak is a worthwhile choice if you don't need QIC-80 compatibility.

Another option to investigate is the Micro Solutions Backpack Tape Drive. This $669 product offers remarkable ease of use thanks to its parallel-port operation and software that consists of only a single file, which makes it easy to copy among systems that may need to share the drive. Performance on the Full Disk Backup test was noteworthy, and the Backpack achieved solid midlevel scores elsewhere. Anyone can appreciate its performance and features set, but laptop users particularly will admire its convenience.

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this review—but did not send it. Each drive subsystem had to offer data-compression support in software and be able to use extended-length tape. We allowed companies to enter OEM drives, as long as they provided proprietary software or modified any OEM software or hardware.

Laguna Conversion Systems and Alliance make products that fit these criteria (the latter makes a parallel-port product much like Micro Solutions'), but were unable to send them to us in time for this review. Novastor also offers a comparable drive/software package but did not send it in time. Novastor (Westlake Village, California; 818-707-9900) sells its *NovaWare* software separately for use with any of the reviewed drives and with DOS, OS/2, Macintosh, and other platforms. Legacy offers a tape drive but its software doesn't support data compression. Compaq provides an internal tape drive that supports the QIC-80 standard, but it declined to participate in the review.

These minicartridge packages are all true systems, comprising not only tape drives but also controllers or interfaces, software, documentation, cables, and warranty and service agreements.

Minicartridge backup is not yet trouble-free, but it has certainly improved, especially in terms of software and ease of use. It's always wise to take precautions and enable verification during backups, but all things considered, single users and small-network administrators will find that minicartridge backup is probably the most effective solution to meet their needs today.

ALLOY COMPUTER PRODUCTS INC.

Alloy Retriever/250ce

BY JOSEPH DESPOSITO The Alloy Retriever/250ce, from Alloy Computer Products, makes its mark as an external tape drive that is simple to install and operate. If you're concerned more with price than with simplicity, you should know that the unit requires an "optional" controller that will add $195 to the tape drive's $625 suggested retail price, for a total cost of $820. You don't get added speed with the proprietary FTFA/AT controller; its maximum transfer rate is the standard 500 kilobits per second.

Installing the Retriever/250ce is almost as easy as screwing in a light bulb. Install the half-size controller card, connect the tape drive, and you're done. There are no power cords to worry about (power comes from the computer bus) and no detours to the floppy disk drive connector. You don't even need to turn on the power to the drive; it doesn't have a switch. Tapes slide all the way into the drive and are ejected with a push button.

The drive stands just 2 inches high when set horizontally. A mounting stand is included if you prefer a vertical orientation, and a 3M DC-2000–series extended-length tape comes standard. The cable that connects to the controller card is built into the drive and cannot be removed.

EASY SOFTWARE

ResQ120, Version 2.0, is included with the unit. Not only is the device itself manufactured by Archive, but *ResQ120* is Alloy's modified version of Archive's *QICstream* software. The software is virtually the same as that used with the Micro Solutions tape drive, which also comes with a modified version of the *QICstream* product. *ResQ120* is menu-driven and very easy to use. The main menu option can be selected either by pressing the initial letter or by the point-and-shoot method. *ResQ120* is a DOS product; a Microsoft Windows alternative is not available (though the software will work in the Windows environment).

The software offers file-by-file backup and restore operations—but not image backups or restores—with or without compression and verification. You may display a directory of files and format or erase a tape, among other things. You select or tag directories and files from a table rather than a tree diagram. If desired, you may back up only modified files. If your hard disk is larger than the capacity of the tape, you may restore to multiple tapes.

One gripe is that the software automatically defaults to appending files to the tape. If you want to erase previous information on the tape, you need to do it as a separate step from a tape utilities menu, which is easy to forget. The erase process is a quick one, though, taking less than a minute.

KEYSTROKE MACROS

If you want to automate your backups, you can do so by creating macros. Macros are created by example (the software remembers your keystrokes) rather than

FACT FILE

Alloy Retriever/250ce
Alloy Computer Products Inc., One Bngham St., Marlborough, MA 01752; 508-481-8500.
List Price: With standard cabling, one formatted tape, *ResQ120*, FTFA/AT controller, $820; internal tape drive, $525; FTFA/AT controller, $195.
Requires: 256K RAM, hard disk, DOS 3.0 or later.
In Short: The Alloy Retriever/250ce offers good performance, simple installation, and easy-to-use software, although it did produce errors when using a preformatted tape from the company While the price is a little high, if you want simplicity and good speed, the Retriever/250ce provides it.

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through the use of a macro language.

ResQ120 lets you format a tape with as many as 28 tracks or as few as 2 tracks—a feature lacking in some competitive products. The tape supplied by Alloy was formatted with 20 tracks. Like other drives we tested, the Retriever/250ce produced errors when using the company-supplied preformatted tape. For example, after the system backed up a directory without problems, an error message appeared when we attempted to restore it. This message occurred even after the backup had been verified.

As with most of the other units, formatting a new tape in the Alloy drive cured any error problems. The top speed of the Retriever/250ce on the Full Disk Backup test was 27 minutes 2 seconds, while restoring took 13 minutes 20 seconds. Scaling things down to a 30MB directory took 16 minutes 13 seconds for a backup and 8 minutes flat for the restore. On the Single File Find and Single File Restore tests, the system came in with a score of 2 minutes 28 seconds and a fast 1 minute 26 seconds, respectively. These numbers placed the Retriever/250ce in the middle of the group for products tested in their standard configurations, but with fast tendencies. In fact, when you exclude the standard-configuration results for systems that included an accelerated controller or did not allow for verification, the Retriever/250ce's performance is even more impressive.

Alloy offers a complete line of external and internal tape backup systems from 125MB to 2.5GB for use with the IBM PC, XT, AT, PS/2, and compatible computers. All drives include software, and except for the Retriever/125C, all include tape. The internal version of the unit reviewed is priced at $525 and comes in a 3.5-inch form factor.

Alloy warrants the Retriever/250ce tape drive for a period of one year from the date of purchase on parts and labor, and a technical support bulletin board is available for end users. Phone technical support is free of charge from 9:00 to 5:00 (E.S.T.) weekdays, but it's not a toll-free call.

The main attractions of the Alloy Retriever/250ce are the ease of hardware installation and software operation, as well as good performance. This must be weighed against the additional cost of the controller board and a lack of any accelerated controller options for those who would benefit from them. For DOS users willing to pay extra for the sake of simplicity and quick speed, the Alloy Retriever/250ce is a worthwhile choice.

COLORADO MEMORY SYSTEMS INC.

Colorado Memory Systems Jumbo 250 External

BY MITT JONES The Colorado Memory Systems Jumbo 250 External may seem to present shoppers with a serious dilemma: With a list price for the internal version as low as $350, you have to wonder just how good this drive can be. Fortunately, Colorado Memory Systems has worked hard to ensure that the more you learn about this drive, the more you'll like it.

Colorado, which manufacturers its own drives, has kept costs down in part through its one-drive-fits-all approach. Whether you need an internal or an external drive for an ISA XT-class machine or a 386-based PS/2, you'll receive the same $350 internal unit as every other buyer. To install the Jumbo 250 as an internal drive in a PS/2-class machine, you need an

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additional $69.95 KM-20 hardware kit. For a PC or XT with a slow, 250-kilobit-per-second floppy disk drive controller transfer rate, you'll need the $129.95 FC-10 controller to get the transfer rate up to 500 kilobits per second. Because this roundup called for evaluation of external drives, we received the $159.95 KE-10 external chassis to house the Jumbo 250, bringing the list price of our unit to a still-low $509.95. A formatted tape adds $40.85 to the price.

WHAT'S IN THE BOX

The KE-10 comprises a Y cable to tap into your system's power supply, a ribbon cable for hooking to your system's floppy disk adapter, a slot-bracket connector to pass the signals and power to the external unit, and an empty external housing. Your most challenging chore while installing the external drive will be to remove the drive rails, side brackets, and face plate from the basic internal unit, set the drive into the bottom half of the external housing, fit the face plate at the front of the housing, then snap on the top half. Colorado provides well-illustrated documentation to help you along. The plastic housing, which includes a small fan, measures 2.5 by 4.5 by 9 inches (HWD).

The advantages here, aside from cost savings, lie with the flexibility this approach provides all buyers and the low inventory cost requirements it imposes on MIS managers. Let's say you buy the basic internal unit now for your AT/386 with two floppy disks and one hard disk (the basic unit now includes the cabling necessary to install the drive along with two internal floppy disks, which until recently cost buyers another $22.95). If you decide in a few months that you want to install a CD-ROM drive or second hard drive in the bay where the tape drive is installed, you need only order and install the external kit. If you decide you want better backup performance, you can order and install the $299.95 TC-15 accelerator/compression controller, which can boost the transfer rate from 500 kilobits per second to 1 megabit per second.

In operation without its accelerated controller installed, our evaluation unit performed competitively on PC Magazine Labs' tests. Colorado offers no image backup, which didn't affect our tests, as all systems were tested in file-by-file mode. With verification enabled, the Full Disk Backup took 29 minutes 4 seconds and the Full Disk Restore required 13 minutes 44 seconds; the 30MB Directory Backup test required 17 minutes 2 seconds, while the restore took 8 minutes 25 seconds. It took 2 minutes 35 seconds to restore a single file. These scores placed the drive in the middle of the group.

Tested with verification off and the TC-15 accelerator board (which provides QIC-122 compression in hardware) installed, the Jumbo 250 leaped ahead of much of the accelerator-equipped competition, performing especially well on full disk backups and directory restores. It also placed within the top three on the Full Disk Restore and Directory Backup tests. Formatting a tape took less time with the accelerator than without it—about 61 minutes.

JUMBO SYSTEM SOFTWARE

Colorado ships each unit with its software, *Jumbo Tape,* Version 2.49, which includes support for extended memory and operation across NetBIOS-based LANs and offers both a menu-driven and a DOS command line interface. The menu-driven software doesn't make all operations as immediately clear as one might like (you'll have to consult the manual to figure out how to conduct a backup of files modified since the last backup, for example) but should present no difficulties for most users.

The menu-driven program offers the basic functions most users will need, including selective backup and restore, the scheduling of unattended backups, and the ability to toggle on and off the software's verification, compression, and file-overwrite features. Given that the Jumbo 250 does not let you specify whether or not hidden and system files should be backed up and restored—they will be—the file overwrite setting is an important feature: The default off setting eliminates the possibility that you'll restore hidden DOS system files to a disk that contains a different version of DOS.

Buyers who wish to set up batch files to control their backups will appreciate the Jumbo 250's command line capabilities, which include all functions of the menu-driven software plus a few others. Unfortunately, one of the other features not included in the menu-driven software is the ability to restore a subdirectory to a different path on the logical disk from which it was backed up. This task is common and simple enough to have warranted its accommodation via the menu-driven software.

Colorado offers optional $199.95 Unix/Xenix software for the subsystem, but nothing for OS/2 or Microsoft Windows. The current version of the software will not run under Windows even as a DOS application. The company promises a Windows version of the software for a nominal upgrade fee, but no release date has been set.

The vendor provides a one-year warranty on parts and labor, and offers free technical support from 7:00 A.M. to 6:00 P.M. (M.S.T.) weekdays via an 800 number. Colorado Memory Systems also runs a BBS to deal with user questions.

As one of the few drives actually QIC-80–certified, the Jumbo 250 promises accurate performance and solid QIC-80 adherence. Given the bargain price of the drive, the flexibility of Colorado's one-drive-fits-all approach, the company's impressive commitment to installations across a wide range of systems, and the availability of options such as the TC-15 accelerator, it's difficult to see how you could go wrong buying the Colorado

FACT FILE
EDITORS' CHOICE

Colorado Memory Systems Jumbo 250 External
Colorado Memory Systems Inc., 800 S. Taft Ave., Loveland, CO 80537; 800- 346-9881.
List Price: With standard cabling, ribbon cable, *Jumbo Tape,* external housing, $509 95; internal tape drive, $350; TC-15 accelerated controller, $299.95; formatted tapes, $40.85 each.
Requires: 512K RAM, hard disk, floppy disk drive controller, DOS 2.1 or later.
In Short: It's hard to find a better deal than the Colorado Memory Systems Jumbo 250 External tape drive. It was a competitive performer on all tests, but did particularly well with the accelerator installed and the verification disabled. The Colorado unit also offers the advantage of flexibility, with the option to purchase an internal unit and later upgrade it to an external model. The software supplies all of the basics you'll need, but best of all is the low price.

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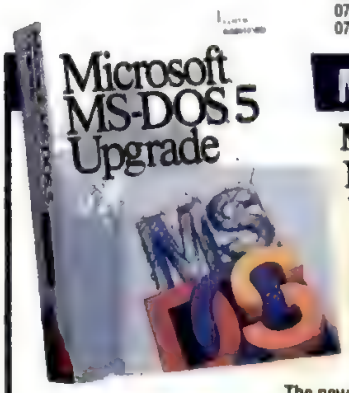

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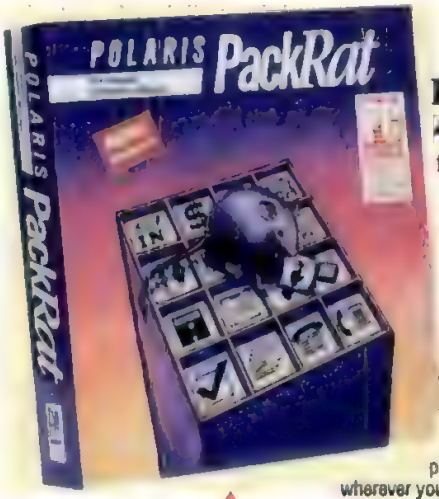

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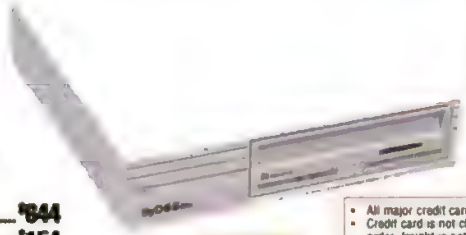

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#20404

Memory Systems Jumbo 250 External—or how you could find a better deal.

CORE INTERNATIONAL INC.

COREtape Light

BY ED PERRATORE CORE International provides many useful and elegant features with its COREtape Light tape drive and is very close to delivering an exceptional product. Unfortunately, the hurdle still to overcome is performance.

The 3- by 4.5- by 7-inch $687 external version includes cables, a three-floppy-disk-drive-capable ribbon connector, one 3M 120MB formatted tape (additional tapes sell for $240 per box of five) and *COREfast,* Version 2.0. The *COREfast* software, though menu- or command line–driven, also allows drive access as a DOS device. And for those who want data compression but want quicker backups than that process normally allows, the software will perform a partial compression while taking up a bit more space on your backup tape.

Our external test drive used an interface connector that ran straight to one of the power supply's connectors (an internal version sells for $429). If your PC is an Olivetti P500 or one of several IBM PS/2s (check with the vendor before purchasing), you'll need to use an external power supply ($75) instead. And if you plan to share the external version among multiple systems, you're best off buying the interface board the company offers to replace the floppy disk drive interface cable. This costs $89 for the ISA CNT-EFT, $109 for the MCA CNT-MCF.

EASY VS. ADVANCED MENUS

Among your first options when you load *COREfast* is selecting between the Easy and the Advanced Main Menus. The Easy choices include file-by-file backup and restore, displaying tape directory, running tape utilities (for example, format, erase, and retention), and changing the configuration level. The Advanced menu adds tasks like image backup and restore, file/catalog management, prescheduled backup, and comparing tape to disk—plus more configuration options.

One handy feature for image operations is the automatic creation of a small file allocation table on a tape. Traditionally, you can only perform an image restore from an image backup. But if you're unable to do an image restore (a common problem if the source disk is dead) the program offers some respite by keeping track of the on-tape location of the first 256 files backed up, thereby letting you do a file-by-file restore of those files instead.

You can also avoid this worry by sticking to file-by-file backup, and here your options are many. While you can't tag files on the fly for file-by-file operations—you must create a catalog of marked files and subdirectories in a separate procedure before initiating the backup process—you can easily include or exclude system, hidden, read-only, and *NetWare*-sharable files. For restores, you can automatically skip or overwrite existing files on-disk (or be prompted file by file). And if you've mounted the program's device driver to address the drive as a DOS device, you can use the same software to restore your tape-based files to floppy disks, a Bernoulli drive, or any other device that uses a DOS drive letter.

FACT FILE

COREtape Light
CORE International Inc., 7171 N. Federal Hwy., Boca Raton, FL 33487; 800-688-9910, 407-997-6055.
List Price: With standard cabling, ribbon cable, one formatted tape, *COREfast,* $687; internal tape drive, $429; external power supply, $75; ISA interface board, $89; MCA interface board, $109; five formatted tapes, $240.
Requires: 256K RAM, hard disk, floppy disk drive controller, DOS 3.3 or later.
In Short: The COREtape Light is a nicely designed system that includes software tailored for both beginning and advanced users. The Advanced menu options provide image backup facilities that are not available in all of the products reviewed, the software also allows drive access as a DOS device. The one hurdle to overcome is performance. On our tests, the COREtape Light was one of the slowest units. If the company works out the problem, this system could be a real contender.

CIRCLE 472 ON READER SERVICE CARD

DISAPPOINTING PERFORMANCE

Two features may be a turn-off. First, there's no fast erase through the *COREfast* interface, as in some of the other drives in this roundup, to wipe away data in a minute; our drive took 52 minutes using the *COREfast* software. (If you're accessing the file as a DOS device, however, a simple "del *.*" will do the job about as quickly as on a hard disk.) Second, you cannot compare tape data to its source disk in the same step as a backup/restore. You can place commands for both in a batch file, but the compare function is not smart enough to keep from prompting you file by file if you're comparing, say, a single file or directory backed up against an entire DOS partition. Full drive backups and restores only can be compared at an unattended PC.

On PC Magazine Labs' Full Disk Backup test, the COREtape Light was the slowest performer among the products tested in their standard configurations, and it also finished in the bottom three on the Full Disk Restore test. Its Directory Backup test result was again the worst of the roundup, and it was unable to perform the Directory Restore test. This last inability may have been caused by a DOS 5.0 incompatibility we encountered during testing. To the vendor's credit, a corrective upgrade file is already available free either by mail or from the company's BBS (407-241-2929). On our Single File Find tests, the COREtape actually provided better scores than six of its competitors, and its Single File Restore test scores were acceptably in the midrange.

The company's warranty covers the unit for 18 months on parts and labor, with free technical phone support from 8:00 A.M. to 6:00 P.M. (E.S.T.) weekdays (8:00 A.M. to 12:00 noon Saturdays) via a toll number.

The COREtape Light has many good features, and the vendor clearly shows it's doing what it can to make the product attractive for a variety of needs. If the tape drive's performance can be brought up to speed in more areas, the COREtape Light will be a true contender.

EVEREX SYSTEMS INC.

Everex Excel 120F

BY JOSEPH DESPOSITO With a suggested list price of $529 (including a power supply), the Everex Excel 120F external

tape drive, from Everex Systems, seems like a very attractive deal. Before you leap, however, you need to consider the software, which has some limitations, and your own hardware configuration.

Although not required in all cases, most users will need an optional interface card, the Everex Extended Floppy Tape Adapter (EV-880). If your floppy disk controller has an external port, you may not need the interface. The interface adds $60 to the cost of the drive. This cost can be offset, however, by purchasing the tape drive without the $60 power supply and using the PC's own power supply instead. The drive we tested came with a power supply and interface card, for a total cost of $589. The price also includes media from 3M.

SMOOTH CONNECTIONS

To install the EV-880 card, you need to place it in an 8-bit expansion slot and then connect it to the floppy disk drive controller, which is on the motherboard on the Compaq machine. Because of the Compaq design, this entailed some cable disconnecting and reconnecting in tight spots, but the process was a fairly smooth one.

FACT FILE

Everex Excel 120F
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; 800-821-0806.
List Price: With standard cabling, one formatted tape, *FTape*, power supply, EV-880 interface board, $589; internal tape drive, $359; power supply, $60; EV-880 interface board, $60.
Requires: 512K RAM, hard disk, floppy disk drive controller, DOS 2.1 or later.
In Short: Excellent performance on our tape backup tests makes the Everex Excel 120F stand out from the crowd. However, its status was achieved without data verification enabled, since the software unfortunately does not support it. The unit also produced errors when using a preformatted tape from the company. In its favor: a very aggressive price, especially if you can do without the EV-880 card and the power supply.

CIRCLE 472 ON READER SERVICE CARD

The floppy disk controller maintains the standard 500-kilobit-per-second transfer rate. Everex plans to offer a 1-megabit-per-second controller, the EV-8628, but it was not ready in time for the review. It's also targeted to work only with another drive offering in the line, the Excel 120DF, which began shipping too late for this review.

Looking like the rhinestone cowboy of tape drives, the Excel 120F sports six LED indicators in a market where most drives have just one. The LEDs are labeled select, read, write, forward, reverse, and power. The Excel 120F also has a power switch on the front panel. Tapes slide all the way into the drive and are ejected by touching a push button. The signal cable connects to the drive and to the Everex interface.

FTAPE SOFTWARE QUIRKS

FTape, Version 3.0, is included in the price of the unit. This software is menu-driven and easy to use. *FTape* is a DOS product; a Microsoft Windows alternative is not currently available, but the company plans to offer one around the third quarter of this year.

The *FTape* software offers image and file-by-file backup, restore, and compare, with or without compression. It also lets you format a tape, test the tape system, and configure the system. You may not verify a backup, however. Instead, the documentation suggests you perform a compare alone. If the compare senses an error, you are advised to perform the tape backup operation again. Files are selected by typing them in or selecting them from a list.

If you intend to restore to a directory not on the current disk, as we did, the software posts an error message. You need to quit the program, create the directory on the disk, and then perform the operation again.

If your drive is larger than the capacity of the tape, you may restore to multiple tapes. In case you want to automate backups, a separate scheduler program is included in the package.

Like other drives that were tested, the Excel 120F produced errors when using a company-supplied preformatted tape. As with most of the other units, formatting a new tape cured the problems. A nice feature of the software is that tape formatting can be done in the background if desired.

FASTEST PERFORMANCE

The Excel 120F was easily one of the fastest drives reviewed among those tested in their standard configurations. It raced through PC Magazine Labs' Full Disk Backup test in 14 minutes 55 seconds. (That's more than 6 minutes faster than the next fastest drive.) Restoring the same data took 12 minutes 4 seconds. The directory backup was also speedy, at just 8 minutes 54 seconds, while the Directory Restore test took a surprisingly long 6 minutes 25 seconds. Unfortunately, all those times were achieved without verification, as the software does not permit it; that means these numbers are not directly comparable with the other products tested in their standard configurations.

The Excel 120F system took longer than any other unit to find a single file—6 minutes 4 seconds, though it restored the file (again with verification off) in a mere 35 seconds.

An internal version of the drive costs $359. The company offers a generous two-year warranty on parts and labor, and free technical support via a toll-free number from 5:00 A.M. to 5:00 P.M. (P.S.T.).

The Everex Excel 120F is aggressively priced, especially if you don't need the extras. Remember that an optional interface board will be needed for most systems at an additional cost. The major knock is on the software, which is not as elegant in operation as some of the others reviewed here, and which does not provide for verification. If you don't mind those drawbacks, you may want to check out the Everex Excel 120F.

IRWIN MAGNETIC SYSTEMS INC.

Irwin AccuTrak Plus A250E

BY WINN L. ROSCH Quick backups, low price, excellent software and instructions—what more could you ask for? Probably QIC-80 compatibility, but the Irwin AccuTrak Plus A250E, from Irwin Magnetic Systems, earns its performance by following its own, proprietary embedded-servo format. Avoiding the QIC-80 standard allows Irwin to play with the storage format, the data density, and the tape speed to increase backup performance.

Thanks to price cuts made last September, the entry-level internal system, the

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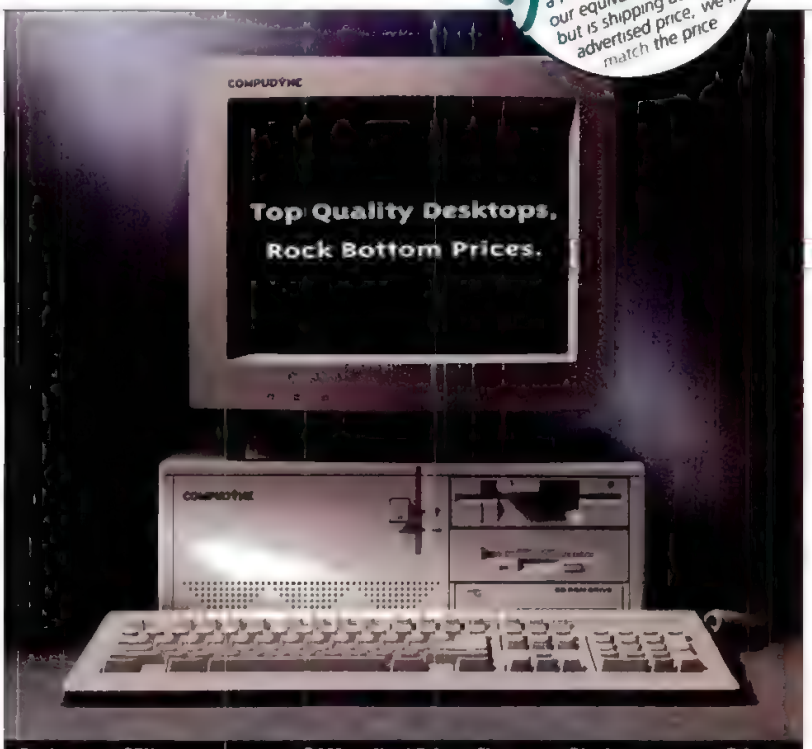

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386DX/25	Intel 80386DX–25 MHz	2 standard 32 max	80	1.2 and 1.44	16 bit SVGA card 14" 1024x768 SVGA color monitor	$1,299 $48/mo*
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CIRCLE 132 ON READER SERVICE CARD

Irwin AccuTrak Plus A250E
Irwin Magnetic Systems Inc., Distribution Div. of Maynard Electronics Inc., 2101 Commonwealth Blvd., Ann Arbor, MI 48105; 800-421-1879.
List Price: With standard cabling, one formatted tape, *EzTape* for DOS and Microsoft Windows, SuperTrak accelerated controller, $778; internal tape drive, $299; standard controller, $79; SuperTrak accelerated controller, $179.
Requires: 640K RAM, hard disk, DOS 3.0 or later, Microsoft Windows 3.0 or later.
In Short: The Irwin AccuTrak Plus A250E proved to be one of the fastest performers on our tests of units in their standard configurations. The good performance may be attributable to Irwin's proprietary technology and its accelerated controller. The system provides the benefit of both DOS and Microsoft Windows software in the same package. In either mode, *EzTape* is easy to master. Be aware, though, that its proprietary embedded-servo technology means that the tape drive cannot exchange tapes with those formatted on other manufacturers' units.

CIRCLE 473 ON READER SERVICE CARD

AccuTrak Plus 250PC, lists for $479 including software. The external $599 AccuTrak Plus we reviewed comes standard with software for DOS and Microsoft Windows and one tape cartridge. As in the Alloy Retriever/250ce, the controller is an optional requirement. You can choose either a $79 500-kilobit-per-second controller or the $179 accelerated SuperTrak controller we received for this review, bringing the tested system cost to $778. (Irwin did not send the 500-kilobit-per-second model.) The downside of these relative bargains is also what helps Irwin make its mark: The proprietary embedded-servo technology means that Irwin drives cannot exchange tapes with those made on other manufacturers' units.

THE IRWIN STANDARD

This may not be as big a penalty as it sounds. Irwin's large market share (40 percent) practically makes it a standard unto itself; the proprietary format enables the higher tape speed (86 inches per second); and the drive's storage capabilities exactly match QIC-80, putting 80MB on standard cartridges and 120MB on extended-length—both approximately doubled with data compression.

Whether the Irwin standard will survive is another issue. In December 1991, Irwin cut its staff by 55 percent as its parent company, Archive Corp., folded Irwin's operations into other divisions; Irwin's retail business, for instance, is now a division of Maynard Electronics. But because the AccuTrak Plus uses standard DC-2000 cartridges and can initialize and format them from blanks, the only downside to taking advantage of the bargain price is the potential danger of not being able to acquire a compatible replacement or duplicate Irwin unit for another PC in the future.

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One reason the price cuts were possible is that Irwin has moved its production to Singapore. The change has made no difference in quality: The drive operates quietly and smoothly. Although the small package of the external unit looks cheap—a bulging, rounded plastic case with a seam around its middle—that part of the system was designed by Irwin in Ann Arbor.

On the positive side, at 5 by 2.5 by 7.5 inches (HWD), the AccuTrak Plus is small enough to fit easily into a briefcase, and its 36-inch signal cable is removable.

Either the standard or accelerated controller functions independently from the host system's floppy disk controller. Internal drives can, however, take advantage of an extra channel in a host PC's floppy disk controller. Installation of the external drive involves only setting a DIP switch bank on the controller, plugging the board in, attaching drive power to it using a supplied Y cable, and connecting the drive to the controller.

EZTAPE SOFTWARE

The Irwin software system, *EzTape*, Version 2.22, has improved considerably over the years while growing to 800K of disk space. The DOS version's primary menu-driven interface can be mastered without a look at the manual by experienced users, yet it offers almost every option, including batch and automatic backup modes.

The software doesn't provide for image backups, but it does offer a BackAll function, which is almost the same thing. While the file-selection system and commands are not obvious, a few minutes of trial and error will get even the most technology-intolerant user going. The most glaring omission is a thermometer display to let you monitor backup progress; *EzTape* only lists the file currently being backed up, so you don't know how far along in the backup process you are.

Better still is the Microsoft Windows version of *EzTape*, which offers not only the same ease of use but also background operation. Start a backup session and shift to another window and *EzTape* keeps the AccuTrak Plus system rolling. An OS/2 Presentation Manager version is also available, but at the ridiculous price of $269.

EXCELLENT SPEED

After you make all of your backup choices—files, directories, or disks—the system swings into action and within 10 seconds is backing up. At the completion of its quick file-by-file stream of data to tape, *EzTape* updates the tape directory and sets disk archive bits (if you want it to) before returning control. On our tests of units in their standard configurations, the 52MB of PC Magazine Labs' test disk required 21 minutes 8 seconds of total system time to back up with the AccuTrak Plus. The directory backup took only 11 minutes 4 seconds, while restoring that data was managed in a blazing 5 minutes 20 seconds. Single file finds took a scant 9 seconds, and a single file restore was accomplished in just under a minute. Keep in mind, however, that in addition to using Irwin's proprietary technology, these scores were achieved using the accelerated controller.

Measured up against the competition equipped with accelerators (and this time with verify off), the AccuTrak Plus still boasted very good speeds for full disk and directory restores—9 minutes 40 seconds and 5 minutes 7 seconds, respectively.

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¼-inch Data Cartridge Tape Technology. The practical, reliable,

3M Magnus LO and L35 data cartridges require a compatible drive. Archive, Maynard, Sankyo, Tandberg, Tecmar and Wangtek have introduced gigabyte ¼-inch drives. ©3M 1992.
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Note that the Directory Restore score with verify off does not differ much from the score with verify on. The scores on the Full Disk Backup and Directory Backup tests in this arena, though, were midrange.

Irwin protects the tape drive with a two-year warranty on parts and labor with return-to-factory service. Phone-in technical help is toll-free, from 8:00 A.M. to 7:00 P.M (E.S.T.) weekdays. If you want an excellent combination of high speed and low price and are willing to accept a standard other than the QIC-80 standard, the Irwin AccuTrak Plus A250E with its accelerated controller is a top choice.

MAYNARD ELECTRONICS INC.

Maynard ArchiveXL 5580e Tape Backup

BY WINN L. ROSCH One-stop shopping is how Maynard Electronics sees its ArchiveXL line. The Maynard ArchiveXL 5580e Tape Backup is a plug-and-play combination of minicartridge hardware (a drive from Archive Corp.'s Ardat corporate division and a proprietary interface board), Maynard's own *QICstream* software, and all of the cables and instructions you need to get going. For the $679 entry fee for the external ArchiveXL (a little over $500 on the street, or $499 list for an AT or Micro Channel internal version), you get a QIC-80 system that will lay up to 250MB on a DC-2120 cartridge using data compression and extended-length tape.

The centerpiece of the system is the Ardat-labeled Archive drive, attractively packaged in a 2.5- by 5- by 9-inch case that comes with a separate flat plastic foot for installing the tiny drive vertically. Unfortunately, the 48-inch permanently attached input cable makes putting the little package inside your attaché cumbersome.

The evaluation system used an 8-bit Maynard 20A interface board that intercepts the cable in your PC running from the floppy disk control circuitry to your drives. On our Compaq machine, this meant loosening the drive bays to gain access to the system board's ill-placed floppy disk connector; anyone owning a PC that makes accessing the connector so difficult should keep this in mind. In internal installations, the drive uses the second channel of your floppy disk controller, although an optional $30 cable allows you to connect the ArchiveXL in a two-floppy-disk-drive PC. Maynard's new 20004 interface was not available in time for this review; it uses a simplified design (ASICs), which will translate into lower cost for the system as a whole.

PLEASANT QICSTREAM SOFTWARE

QICstream, Version 2.0XL, is a single 99K program that includes most backup, restore, maintenance, and batch-mode options. The basic DOS-based interface is menu-driven and easy to navigate. It requires no skill or training to use and has a wealth of features (such as a thermometer-style progress indicator) that shows it to have been carefully thought out and honed. It does lack an image backup and restore mode.

Performance of the ArchiveXL system proved generally on a par with the other units on our tests of systems in their standard configurations. It took 31 minutes 55

n path.

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Maynard ArchiveXL 5580e Tape Backup
Maynard Electronics Inc., 36 Skyline Dr., Lake Mary, FL 32746; 800-821-8782.
List Price: With standard cabling, one formatted tape, *QICstream*, Maynard 20A interface board, $679; internal tape drive, $599
Requires: 384K RAM, hard disk, floppy disk drive controller, DOS 3.0 or later.
In Short: When tested with verification disabled and Maynard's preformatted tape, the Maynard ArchiveXL 5580e Tape Backup produced several unrestorable backups. On the plus side, the *QICstream* software is easy to navigate through and helps you keep track of backup progress via a thermometer-style indicator. Performance on our standard-configuration tests was reasonable, and a new 24-hour technical assistance line should be in place by the time you read this.

CIRCLE 474 ON READER SERVICE CARD

seconds on the Full Disk Backup test and 15 minutes 48 seconds on the Directory Backup test—with all data streaming through the 500-kilobit-per-second interface. Restore times proved quicker, at 13 minutes 19 seconds on the full disk restore and 7 minutes 54 seconds on the directory restore. In fact, if you exclude the accelerator-equipped entries as well as those units that could not be tested with verify on, the ArchiveXL's scores on these two tests are quite admirable. It took the average amount of time to find a single file, but restoring the file was slow, taking 3 minutes 2 seconds.

The *QICstream* software defaults to verifying each backup (as with most products, thus doubling the backup time) and must be manually overridden. With any vendor's product, you'll probably want to keep the verify feature on and put up with the longer wait to ensure data integrity. It's especially true with this system; tested without verify on, the ArchiveXL produced several unrestorable backups when using a preformatted tape supplied by Maynard. Switching verify on prevented such problems.

Maynard offers a one-year warranty on parts and labor backed by a toll-free technical assistance line (scheduled for 24-hour operation by the time you read this). All in all, the Maynard ArchiveXL 5580e Tape Backup is a worthwhile solution that benefits from highly developed software and reasonable performance.

MICRO SOLUTIONS INC.

Micro Solutions Backpack Tape Drive

BY ED PERRATORE No other tape backup product we encountered lets you install it without opening your PC. The $669 Micro Solutions Backpack Tape Drive plugs into your PC's parallel port—a printer can plug right into the rear of the tape drive—for backups and restores that are just as speedy as those performed over more conventional means.

Usable on any DOS-driven PC but especially helpful for laptops, the 2.5- by 4- by 8-inch metal-cased drive comes with a parallel cable, an external transformer, and software; no interface board, connector, or controller is necessary. The source of both drive and software is Archive, but both have been customized to allow parallel-port transfer.

In addition to the quick connection, the Backpack's *BPBackup*, a modified version of earlier *QICstream* software (Version 1.03.03), comprises only one 63K file, for easy copying to systems that may need to share the drive. The company says that its modified version of the software writes data in exactly the same way the original version does and consequently will work with QIC-certified drives from Archive, Colorado Memory Systems, and Mountain Network Solutions.

FILE-BY-FILE VERSATILITY

The *BPBackup* software makes your first backup decision: No image backup is available. The file-by-file capability, however, will get you through any backup of a single file, one or more directories, or a disk partition.

When you select backup from *BPBackup*'s main menu (the interface is the same as that of the Alloy Retriever/250ce), your next options are all, selected, or changed files. Choose selected files and the program presents a table of files and subdirectories. You can't view a directory tree, but the Right and Left Arrow keys will let you step down through the highlighted directory's branches and view or tag the files that lie within.

Selecting files and directories is simple: If you tag a directory, the program highlights all files and subdirectories in that directory. The less sweeping route is pressing *I* for Include and typing in a file specification, using DOS wildcards if you want. You can also hit *E* to exclude a specific group out of your tagged files, although you'll have to handle system or hidden files manually. *D* lets you include or exclude files by date range.

If you need to restore, *BPBackup* requires that you choose from among file sets on a given tape; among statistics noted on this screen are password protection status and set size. You can easily redirect the restore to another drive or directory, or select from files and directories on a screen identical to that used for backup select.

The Backpack did well on PC Magazine Labs' standard-configuration performance tests. It ran in the top five on both disk and directory backup tests (its 26-minute-45-second Full Disk Backup score was particularly speedy) and dropped only slightly further into the

Micro Solutions Backpack Tape Drive
Micro Solutions Inc., 132 W. Lincoln Hwy., DeKalb, IL 60115; 815-756-3411.
List Price: With standard cabling, external transformer, *BPBackup*, $669.
Requires: 384K RAM, hard disk, parallel port, DOS 3.0 or later.
In Short: As the only tape backup unit we reviewed that can be installed without having to open your PC, the Micro Solutions Backpack Tape Drive plugs right into your parallel port and provides performance comparable with units installed by more conventional means. The unit offers easy-to-operate software (a modified version of *QICstream*) and is particularly appropriate for laptop users.

CIRCLE 475 ON READER SERVICE CARD

average with its restore scores. To restore a single file, the Backpack took 2 minutes 4 seconds, which placed it in the midrange.

NETWORK BACKING

If you want functions like automated backups of a single machine or a network server, *BPBackup*'s macro facility lets you record keystrokes and play them back when you wish. The program includes no batch file and little command line support, so you can't perform external operations like logging off your network after a backup. One helpful feature is the program's TSR wake-up alarm: It provides a 5-minute warning before executing a macro. If you're called away from your desk unexpectedly, the macro commands the program will issue go to the application you're in rather than the backup drive; other tape products reviewed will not execute a macro or batch file until you have exited the application.

Micro Solutions provides free, unlimited support Monday to Friday, from 9:00 A.M. to 6:00 P.M. (C.S.T.) via a toll number; you can also dial in 24 hours to a BBS expected to be operative by the time you read this. You can work with either dealer or vendor for service during the one-year warranty period. Check out the Backpack if you want competitive performance, great ease of use, and easy portability.

MOUNTAIN NETWORK SOLUTIONS INC.

Mountain FileSafe External 8000Plus

BY KELLYN BETTS In its standard configuration without an accelerated controller, Mountain Network Solutions' $1,149 Mountain FileSafe External 8000Plus is among the most expensive tape drives we reviewed. With its $295 optional accelerated controller, the MACH², the system becomes even more costly—$1,444. In the latter configuration, however, the FileSafe uses the least costly consumables; only with the accelerator card is the drive capable of backing up directly onto unformatted tapes. This could be significant for users regularly purchasing a large number of tapes, since unformatted tapes cost a little less than their formatted counterparts.

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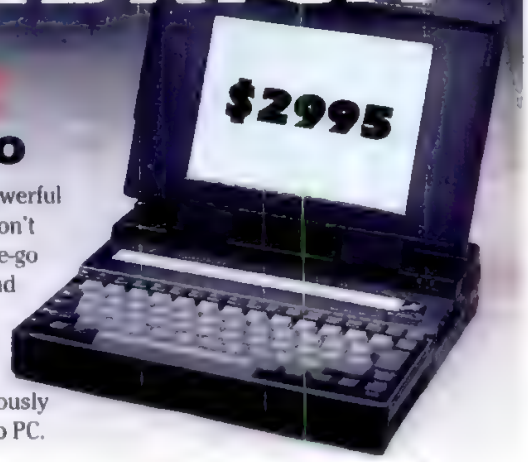

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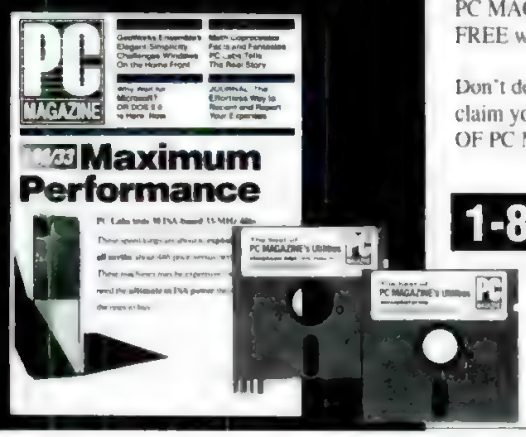

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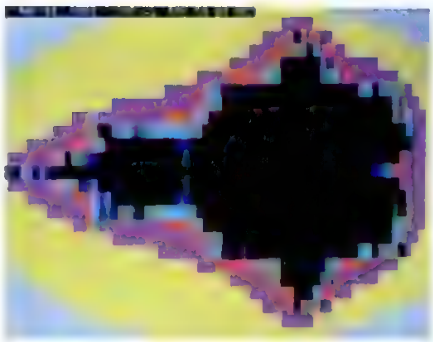

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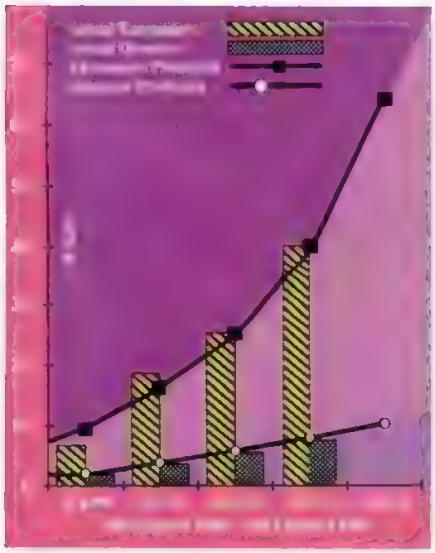
*All data from Dataquest/National Computer Security Association virus study (11/91).



Actual and projected percent of organizations experiencing virus disasters each quarter in North America (Dataquest).

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Viruses are no longer someone else's problem, as many businesses have discovered. When a virus hits, it can not only destroy your data and programs, it can also knock out your entire network. A virus puts you off-line until the problem is solved, while it ties up your best people for hours or days. With NOVI, you're always protected and productive.

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Software Digest

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CIRCLE 138 ON READER SERVICE CARD

SUMMARY OF FEATURES

Products listed in alphabetical order

The 13 tape drives reviewed here have a number of characteristics in common. For instance, all of the tape drives come with software that supports automatic unattended operation, and they can all set the archive bit after the backup procedure. Every tape drive except for the Alloy Retriever/250ce allows for DOS command line operation, and all but the Retriever/250ce and the Micro Solutions Backpack Tape Drive offer batch-mode operation.

Only the Everex Excel 120F and the Summit Express SE250 Tape Backup support more than one tape drive per system: The Excel 120F supports four and the Summit Express supports two.

The software accompanying all of the tape drives is capable of both backing up and restoring single files, single directories, subdirectories, and DOS partitions. The software lets you back up across several disks or cartridges; all of the software also allows you to turn data compression off.

Most of the vendors include only DOS-based versions of their backup software. However, the Summit Memory Systems and Wangtek units (which offer *Central Point Backup* software), as well as the Irwin Magnetic Systems tape drive (which provides its own *EzTape* software), include Microsoft Windows versions as part of the package. Currently, none of the vendors provide backup software for OS/2 as part of

★—Editors' Choice
■—Yes ❑—No

	Alloy Retriever/250ce	Colorado Memory Systems Jumbo 250 External	COREtape Light	Everex Excel 120F	Irwin AccuTrak Plus A250E
List price	$820.00	$509.95	$687.00	$589.00	$778.00
Device type	External	External	External	External	External
Dimensions (HWD, in inches)	2 x 6 x 9.5	2.5 x 4.5 x 9	3 x 4.5 x 7	2.5 x 6 x 10.5	2.5 x 5 x 7.5
STANDARD COMPONENTS					
Number of DC-2000 tape cartridges included	1	None	1	1	1
Manufacturer	3M	N/A	3M	3M	3M
Standard-configuration controller	■	❑	❑	❑	■
Accelerated	❑	N/A	N/A	N/A	■
ISA 8-bit	■	N/A	N/A	N/A	■
OPTIONS					
Accelerated controller	None	$299.95	None	None	Included
Interface type	N/A	ISA 16-bit	N/A	N/A	ISA 8-bit
Other available controllers or interfaces	EISA, MCA	None	MCA	EISA, MCA	MCA
PHYSICAL CHARACTERISTICS					
Media speed (inches per second):					
Standard configuration	34	34	73	50	86
With optional accelerated controller	N/A	68	N/A	N/A	86
Device manufacturer	Archive	Colorado Memory Systems	CORE	Everex Systems	Archive
Power source	Host	Host	Host	Direct AC plug	Host
SOFTWARE CHARACTERISTICS					
Software (tested configuration)	*ResQ120*, Version 2.0	*Jumbo Tape*, Version 2.50	*COREfast*, Version 2.0	*FTape*, Version 3.0	*EzTape*, Version 2.22
Background operation	❑	❑	■	❑	■ (Microsoft Windows version)
Password protection	■	■	■	■	■
Compatible third-party software	*Central Point Backup*	*Central Point Backup, Norton Backup*	*Central Point Backup, PC Tools, Sytos*	None	*Central Point Backup, PC Tools*
BACKUP AND RESTORE CHARACTERISTICS					
Backup and restore types permitted:					
Image	❑	❑	■	■	❑
Modified image	❑	■	❑	❑	❑
File-by-file	■	■	■	■	■
Backup and restore range types:					
Entire disk	■	■	❑	■	■
Multiple disks or partitions	■	■	❑	■	■
Copies hidden and system files during backups:					
Image	N/A	N/A	■	■	N/A
File-by-file	User option	■	User option	User option	User option

N/A—Not applicable: The product does not have this feature.

their standard configuration, but Irwin offers it at an additional cost of $269.

Another distinguishing feature found in some of the tape drives is the availability of a controller, which may or may not be accelerated. If the product does not provide a controller of its own, it relies on an interface card or a connector to attach to the floppy disk drive controller. The Colorado Memory Systems Jumbo 250 External, the Mountain FileSafe External 8000Plus, the Summit Express SE250 Tape Backup, the Tecmar MiniVault 250, and the Wangtek E3080PK rely on the interface approach in their standard configurations, but offer controllers as optional items; CORE International, Everex Systems, Maynard Electronics, and Tallgrass Technologies Corp. (in the context of the Tallgrass FS250e) do not offer controllers at all. The Alloy Retriever/250ce and the Irwin AccuTrak Plus A250E do not include controllers in their base prices, but the controllers are required options (we include the cost of the Retriever/250ce's standard controller and AccuTrak's accelerated controller for the List Price entries on the features table). The Micro Solutions Backpack Tape Drive is unique in that it does not require a controller interface card or connector: It simply plugs into a PC's parallel port.

Maynard ArchiveXL 5580e Tape Backup	Micro Solutions Backpack Tape Drive	Mountain FileSafe External 8000Plus	Summit Express SE250 Tape Backup	Tallgrass FS250e	Tallgrass FS300e	Tecmar MiniVault 250	Wangtek E3080PK
$679.00	$669.00	$1,149.00	$385.00	$825.00	$1,195.00	$699 00	$699.00
External	External	External	Internal	External	External	External	External
2.5 x 5 x 9	2.5 x 4 x 8	2.3 x 5 x 11	2 x 4 x 6.5	4.5 x 4 x 8 5	4.5 x 4 x 8.5	3.5 x 5.5 x 8	3.5 x 5.5 x 8
1	None	None	None	1	1	1	1
3M	N/A	N/A	N/A	3M	3M	3M	3M
◗	❑	❑	❑	❑	■	◗	❑
N/A	N/A	N/A	N/A	N/A	■	N/A	N/A
N/A	N/A	N/A	N/A	N/A	■	N/A	N/A
None	None	$295	$295	None	Included	$229	$199
N/A	N/A	ISA 8-bit	ISA 8-bit	N/A	ISA 8-bit	ISA 8-bit	ISA 8-bit
MCA	EISA, MCA	ISA-16 bit, MCA	ISA 16-bit, MCA	EISA, MCA	EISA, MCA	MCA	EISA
50	25	68	34	34	68	34	34
N/A	N/A	68	68	N/A	N/A	68	68
Archive	Archive	Summit	Summit	Archive	Summit	Wangtek	Wangtek
Host	External transformer	Direct AC plug	Host	Direct AC plug	Direct AC plug	Host	Host
QICstream, Version 2.0XL	*BPBackup*, Version 1.30.03	*FileSafe*, Version 2.35	*Central Point Backup*, Version 7.1	*FileSECURE*, Version 1.52	*FileSECURE*, Version 1.52	*MiniVault*, Version 1.3	*Central Point Backup*, Version 7.1
◗	❑	❑	■	❑	❑	❑	■
■	■	■	■	■	■	❑	■
Central Point Backup, PC Tools	None	*Central Point Backup, PC Tools*	None	*Central Point Backup*	*Central Point Backup*	*Central Point Backup*	*Sytos*
◗	◗	■	❑	❑	◗	■	❑
❑	❑	❑	❑	❑	◗	■	◗
■	■	■	■	■	■	■	■
■	❑	■	■	■	■	❑	■
❑	❑	■	■	■	■	❑	■
N/A	N/A	■	N/A	N/A	N/A	■	N/A
User option	User option	■	User option	■	■	User option	User option

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Adobe Streamline Windows	120
Adobe Type Manager Windows	59
After Dark	27
Ami Pro 2.0	275
Toolbook	280
Becker Tools	70
Borland C++	289
Carbon Copy for Windows	111
Charisma	322
Corel Draw 2.0	359
Crosstalk for Windows	115
IBM Current	213
dBFast	289
Designer	446
Drafix Ultra Windows	410
Facelift for Windows	59
Facelift for Windows ValuePak	117
Form Base w/Windows	295
Form Publisher w/Fill and File	105
Grammatik for Windows	55
Harvard Graphics for Windows	339
hDC FileApps for Windows	70
hDC FirstApps for Windows	53
hDC ICON Designer	32
hDC Windows Express	53
Lotus 1-2-3 for Windows	395
MS Entertainment I,II,III	25
MS Excel for Windows	293
MS PowerPoint for Windows	293
MS Productivity Pack	36
MS Project for Windows	412
MS Word for Windows	293
Norton Desktop	93
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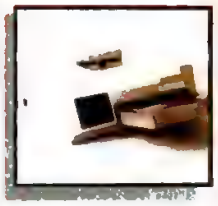

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80387-DX 33	158
80387 SX-16	☎ 98
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- Copy II Option Board Deluxe 109
- **Copy II PC 6.0** ☎ 23
- Norton Editor 65
- Super PC-Kwik 43

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- Lotus Magellan $95
- Mace Utilities 1990 92
- **Norton Utilities 6.0** ☎ 109
- PC Tools Deluxe 7.1 96
- QDOS III 41
- SpinRite II 59
- **XTree Gold 2.5** ☎ 88

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- **Qemm 386** ☎ 35

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- **Power Menu Plus** ☎ 68

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- 486-33/128C, 4MB, 210/425 M, Win 3.0 & Logi Mouse, Non-Intrlcd SVGA 2449

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  - Action Laser II $699
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  - Desk Jet 500C 749
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  - Laser Jet III 1589
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  - OL-830 1349
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  - All Models ..... Call
- Zoom
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  - XC 1410 C EGA 236
  - XC 1429 C VGA 389
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  - Multisync 2A 389
  - **Multisync 3FGX 14"** ☎ 637
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  - Multisync 5FG 17" 1345
  - Multisync 6FG 20" 2799
- Princeton
  - Princeton Ultra 1400 420
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- Sony Multiscan 1304 HG 14" 612
- Zenith ZCM 1492 598

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- Colorado Memory System
  - Jumbo 120/250 INT $255
  - **Jumbo 60/120 INT** ☎ 195

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- **Dr. DOS v6.0** ☎ $64
- MS DOS 5.0 Upgrade 59
- MS DOS 5.0 OEM 49
- MS DOS 5.0 (Microsoft) 69
- MS Windows Ver. 3.0 66

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- Drafix Ultra v4.0 234
- Harvard Graphics 3.0 399
- Lotus Freelance Graphics 4.0 315

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- Clarion
  - Personal Developer $42
  - Professional Developer 444
- Clipper 5.0 498
- Data Perfect 269
- dBFast 269
- Dbase IV 449
- FoxPro Single User 2.0 449
- Paradox 3.5 469
- **Q&A** ☎ 299
- R-Base 3.1 455
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  - Speed Star Hi-Color 180
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  - Above Board + 512K Plus 279
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  - Inboard 386 PC (1MG) 489
  - Other Models ..... Call
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  - Tiny Turbo 286 118
  - Tiny Turbo Xtra 175
  - Other Models ..... Call
- Paradise
  - VGA + 256K 105
  - VGA + 16 125
  - VGA 1024 512K 190
- Video 7
  - 1024 I w/256K 125
  - Other Models ..... Call

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- Lotus 1-2-3 Ver. 3.1 + ... 399
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- **Logitech Mouseman Serial /PS2** ☎ 65
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- Maxtor
  - 7080 80MG IDE w/CNT 289
  - LXT 213A 200MG IDE w/CNT 599
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  - All Models ..... Call
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  - ST3144A 130 MG 375
  - ST3096 A MG 289
- Other Models ..... Call
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  - 3.5" 1.44 MG AT 59
  - 5.25" 1.2 MG AT 80
- **Toshiba 3.5 1.4 MG** ☎ 56

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- ACCPAC BPI
  - AP, AR, GA, INV. Payroll $230
- DAC Easy Bonus Pack 4.2 122
- DAC Easy Payroll 4.2 59
- One Write + Acct. Works 189
- Pacioli 2000 27
- **Peachtree III w/Data Query** ☎ 219
- TimeSlips III 4.0 183

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- Carbon Copy Plus 6.0 ..... $110
- Crosstalk Mark4 132
- Co/Session Remote 70
- Mirror III 79
- **Procom Plus v2.0** ☎ 62
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CIRCLE 206 ON READER SERVICE CARD

Mountain also sells a $795 internal version that, like the standard external version, runs off the floppy disk drive controller with the aid of an interface connector.

PROPRIETARY TD-101 FORMATTING SCHEME

In order to format on the fly, the FileSafe needs to use its proprietary TD-101 formatting scheme, an alternative to the QIC-80 standard. The TD-101 scheme also allows the FileSafe drive to cram more data onto a tape—up to 152MB without compression. The TD-101 formatting scheme is the default when the accelerator is in use, but that can be changed with the DOS-based *FileSafe*, Version 5.2.3, TD software that is bundled with the drive.

Mountain's tape backup software has a plain interface but contains all the features needed to back up data. Capable of coordinating both image and file-by-file backups of anything from entire disk volumes to single files, the software includes the ability to perform selective backups—for instance, for files modified since the last backup took place. In place of using the DOS archive bit to perform these selective backups, *FileSafe* defaults to actually writing the date of each backup it performs in a hidden file. This eases the process of doing a selective restore, because the software can tell whether the last backup used will be sufficient to restore all the needed data.

The *FileSafe* software can't operate in the background, but it can perform automatic unattended batch backups. You can avoid the software's Spartan interface altogether by initiating commands from the even more Spartan DOS prompt, an alternative that Mountain claims is used by 90 percent of its users.

HOW IT PERFORMS

On our tests of systems in their standard configurations, the FileSafe system achieved scores that veered from the midrange to being on the slow side; it did best in this arena on the Single File Find test, where it accomplished its task in a speedy 47 seconds. On the Single File Restore test, however, the unit was the second-slowest unit we saw. The FileSafe's apparent use of verification during the restore process (rather than just the backup process) is likely responsible for its longer restore times.

With the accelerator installed and verification turned off, things improved. Here, the FileSafe unit achieved one of the best Full Disk Restore scores (9 minutes 18 seconds) and was in the midrange on the Directory Restore test. However, it did poorly on the Full Disk Backup test, and produced one of the poorer scores on the Directory Backup test.

The drive we tested comes with a 1-year parts-and-labor warranty. Phone technical support is free from 7:30 A.M. to 4:00 P.M. (P.S.T.), but it's a toll call.

FACT FILE

Mountain FileSafe External 8000Plus
Mountain Network Solutions Inc., 240 Hacienda Ave., Campbell, CA 95008; 800-458-0300.
List Price: With standard cabling, *FileSafe*, $1,149; internal tape drive, $795; MACH² accelerated controller, $295; two formatted tapes, $95; five formatted tapes, $229.
Requires: 512K RAM, hard disk, floppy disk drive controller, DOS 2.1 or later.
In Short: The Mountain FileSafe External 8000Plus drive—available with or without the additional purchase of the accelerated controller—is one of the most expensive units reviewed. However, its ability to use its proprietary formatting scheme and its default to formatting on the fly when the accelerator is installed can save you from the extra cost of consumables. The software is Spartan, but it eases the process of doing selective restores and is able to perform image backups.

CIRCLE 476 ON READER SERVICE CARD

The Mountain FileSafe External 8000Plus tape backup carries a hefty price, but with the accelerator's on-the-fly formatting, you can conserve on media costs.

SUMMARY OF FEATURES

Products listed in alphabetical order

—Editors' Choice
■—Yes ❑—No

	Alloy Retriever/250ce	Colorado Memory Systems Jumbo 250 External	COREtape Light	Everex Excel 120F	Irwin AccuTrak Plus A250E
NETWORK CHARACTERISTICS					
Networks supported	*NetWare, PC LAN, 3+Open*	*NetWare, 3+Open*	*NetWare, 3+Open*	*NetWare*	*Microsoft LAN Manager, NetWare, PC LAN, 3+Open*
Unix support	❑	■	❑	❑	■
Backup system resides on workstation/server	■/■	■/❑	■/❑	■/❑	■/❑
Workstation automatically logs off network after unattended backup	❑	❑	■	■	❑
Tape system supports multiple volumes on single tape	■	■	■	■	■
INTERNAL TAPE DRIVES					
Optional internal tape drive	$525	$350	$429	$359	$479
Form factor (in inches)	3.5	5.25	3.5	5.25, 3.5	5.25

N/A—Not applicable: The product does not have this feature.

If the idea of conserving media costs appeals to you (or if you know you're going to use a lot of tapes), the tape drive/accelerator combination represents a great option.

SUMMIT MEMORY SYSTEMS INC.

Summit Express SE250 Tape Backup

BY KELLYN BETTS The Summit Express SE250 Tape Backup internal drive starts out with a winning combination of qualities. Its $385 retail price is reasonable (as is the cost of a $25 supplemental ribbon cable), and the approximately $225 required to buy the drive through mail order makes it downright cheap. We reviewed the internal system because the company does not offer an external unit.

To run the Summit Express requires nothing more than a free 3.5-inch or 5.25-inch bay and access to your computer's floppy disk drive controller, though Summit Memory Systems offers an optional $295 accelerated controller. The controller, which Summit simply calls the Accelerator Board, is the same one sold by Mountain Network Solutions, though with fewer functions.

What *Central Point Backup*, Version 7.1, adds to this bundle is well-designed versatility, not to mention virus detection. Two versions of the software come with every drive: one for DOS and one for Microsoft Windows. Both versions provide the same set of functions.

The software, which Wangtek also provides with its tape drive, stands out for providing three data-compression options. If speed is important, you can choose to use compression so that it minimizes the amount of time required to complete your backup. *Central Point*'s second compression option concentrates on conserving tape by reducing file sizes as much as possible. The third option is a hybrid of the other two: compressing to get reasonable speed while minimizing the amount of tape used per megabyte. You can, of course, also opt to use no compression.

Whichever compression option you choose, *Central Point* directs files to be placed on the tape sequentially and in their entirety. Like many other systems we saw, the software does not perform image backups. Instead, the software creates two types of file-by-file backups: full and full copy. Full selects all files and resets the DOS archive bit; full copy does not reset the archive bit.

The software automatically formats a tape only when backing up, but nowhere are you given the option to format one yourself. Summit recommends users buy preformatted cartridges. Summit defends *Central Point*'s shortcomings in the formatting area: It claims that most users purchasing preformatted tapes will never need to reformat them, and that if they do need to reuse a tape, overwriting it is a much quicker solution. We did not experience any problems using Summit's preformatted tapes (which were formatted by tape manufacturer Carlisle using Mountain Network Solutions' format utility). It's of interest to note that Wangtek used *Central Point Backup* to format the tapes it supplied for testing, and the Wangtek drive produced errors when using those tapes.

REACHING THE SUMMIT

The Summit Express didn't climb very high on all of PC Magazine Labs' performance tests. On our tests of systems in their standard configurations, it required a long 35 minutes 5 seconds to complete the Full Disk Backup test and 19 minutes 24 seconds for a directory backup. Restore

The Central Point Backup software that comes with the Summit Express offers well-designed versatility and virus protection.

Maynard ArchiveXL 5580e Tape Backup	Micro Solutions Backpack Tape Drive	Mountain FileSafe External 8000Plus	Summit Express SE250 Tape Backup	Tallgrass FS250e	Tallgrass FS300e	Tecmar MiniVault 250	Wangtek E3080PK
NetWare, 3+Open	*NetWare, 3+Open*	*LANtastic, NetWare*	*NetWare*	Any NetBIOS network, *NetWare*	Any NetBIOS network, *NetWare*	*LANtastic, NetWare, PC-Net, 3+Open*	*NetWare*
■	⌟	⌟	■	⌟	⌟	⌟	■
■/⌟	■/⌟	■/⌟	■/⌟	■/⌟	■/⌟	■/⌟	■/⌟
⌟	⌟	⌟	⌟	■	■	■	⌟
■	■	■	■	■	■	■	■
$499	None	$795	*	$575	$995	$519	$479
5 25, 3 5	N/A	5 25	3 5	3 5	3 5	5 25	5 25

* This product is an internal tape drive.

ENDS

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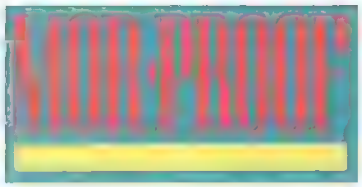

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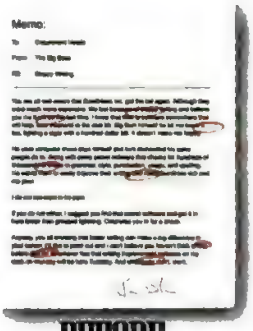

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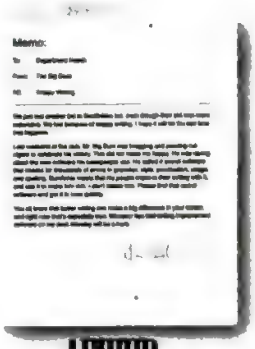

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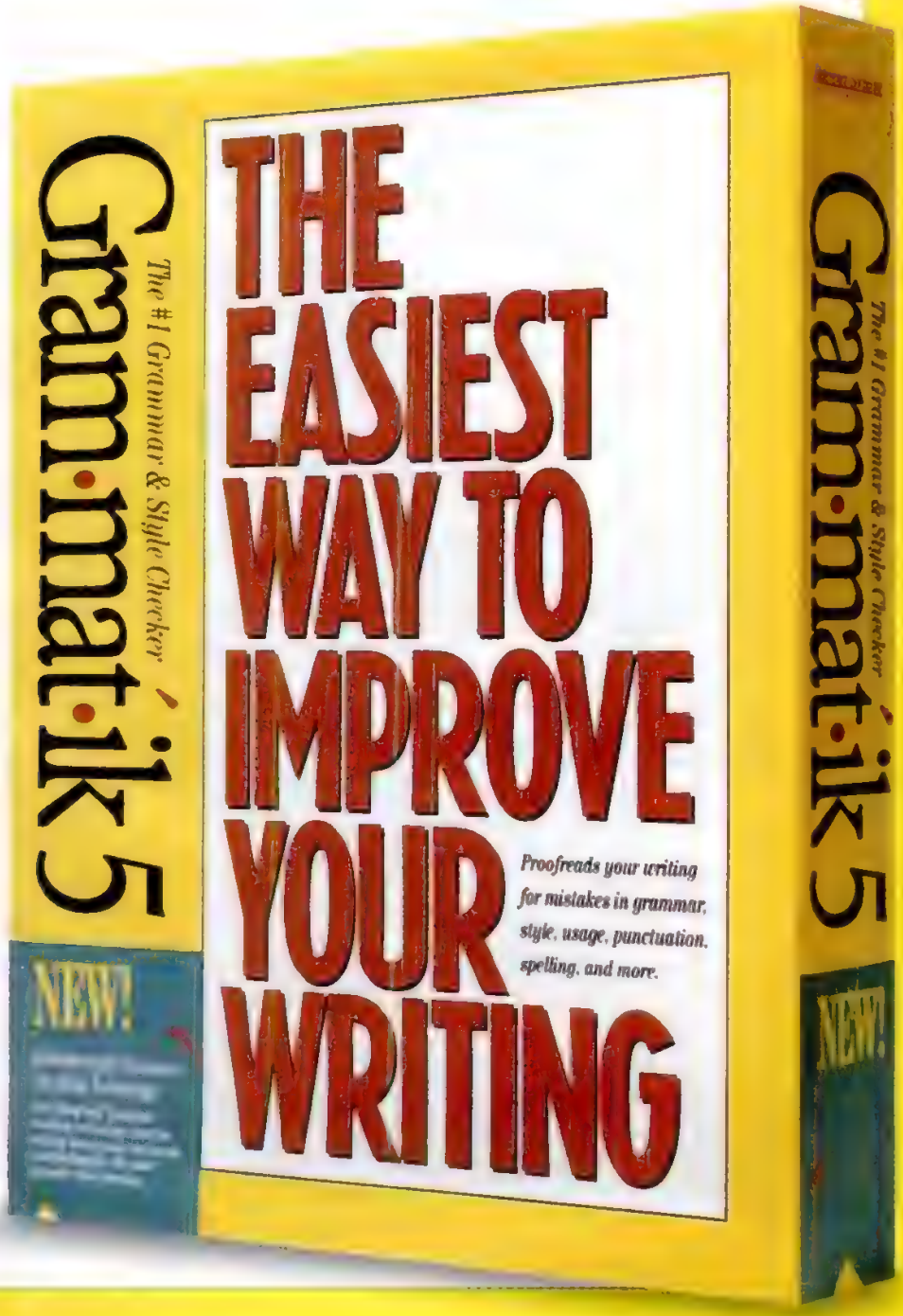

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times were better, with the Summit Express requiring 15 minutes 13 seconds to restore the full disk and 7 minutes 24 seconds to restore the 30MB directory. The 2 minutes 2 seconds it took to restore a single file were on the speedy side of average. On tests with accelerators installed and verify turned off, the Summit Express's Full Disk Restore and Directory Restore times were average, but it provided some of the fastest Full Disk Backup and Directory Backup scores (8 minutes 13 seconds and 5 minutes 15 seconds, respectively).

Setting up the Summit Express for use is especially easy with the *Central Point Backup* software. Once the drive has been screwed into a bay and connected to the floppy disk drive controller (which requires the use of the $25 supplemental ribbon cable if you already have two drives connected to the controller, as in our testbed), you install the software, which automatically looks for the tape drive the first time you invoke it. (The company was planning to change its pricing structure to include the supplemental cable by the time you read this.)

Summit offers a generous two-year warranty on parts and labor, and technical support on weekdays from 7:00 A.M. to 4:00 P.M. (P.S.T.) via a toll-free number.

Because it's an internal unit, no one should be surprised that the Summit Express is cheaper than the external systems reviewed here. However, it is also cheaper than a number of the internal counterparts of the external systems we saw. If you're looking for a good deal, the cost and features set of the Summit Express SE250 Tape Backup make it worth your investigation.

FACT FILE

Summit Express SE250 Tape Backup
Summit Memory Systems Inc., 100 Technology Circle, Scotts Valley, CA 95066-3520; 800-523-4767.
List Price: With *Central Point Backup* for DOS and Microsoft Windows, $385; ribbon cable, $25, accelerator board, $295 five formatted tapes $205 five unformatted tapes, $165
Requires: 640K RAM, 2MB hard disk space, floppy disk drive controller, DOS 3.0 or later, Microsoft Windows 3.0 or later
In Short: The Summit Express SE250 Tape Backup's price is a head-turner Not surprisingly, it's cheaper than the external units tested but it's also less costly than many of the internal offerings from the companies represented here The *Central Point Backup* software offers versatility but is weak on formatting capabilities, however, the preformatted Summit tapes worked just fine. On our tests of systems with accelerators installed and verification disabled, the Summit Express racked up some of the best times.

CIRCLE 477 ON READER SERVICE CARD

TALLGRASS TECHNOLOGIES CORP.

Tallgrass FS250e and Tallgrass FS300e

BY JOSEPH DESPOSITO The Tallgrass FS250e and the Tallgrass FS300e have many things in common: Both tape drives provide the same software, come with a two-year warranty on parts and labor, and come in at the high end of the price spectrum. The FS250e carries a fairly high $825 list price and does not offer much in the way of perks or performance to justify it. The FS300e, at $1,195, is also costly, even if you allow for the accelerated controller that comes as standard equipment.

Installing the FS250e (an Archive unit) is a problem on a system like the Compaq Deskpro 386/25e used in PC Magazine Labs. The tape drive interface provided by Tallgrass consists of a tape drive connector attached to a ribbon cable. The ribbon cable is supposed to fit into the poorly placed floppy disk drive controller connector on the Compaq motherboard, but it doesn't. We needed to attach a hard-to-find adapter cable to the Tallgrass cable before we could get the tape drive to work properly (neither Tallgrass nor PC Labs had the right cable on hand). Any PC with a floppy disk drive controller on the motherboard may cause some minor installation hassles, though they likely won't be as complicated as they were on the Compaq we used.

The FS300e (a Mountain Network Solutions unit) is easy to install. Its controller card does not connect to the floppy disk drive controller. You install the full-size accelerated controller card (made by Summit) in an expansion slot, connect the tape drive to the card with a cable, and you're done. The accelerated controller can be set to work at 500 kilobits per second or at 1 megabit per second through software setup; however, the lower-speed option is required in systems with a 250-kilobit-per-second floppy disk controller. Of course, it doesn't make much sense to buy a unit that incorporates the added cost of the accelerated controller if you can't take full advantage of it.

Both Tallgrass tape drives connect to the AC power line. Both tape drives provide at least 250MB of data storage when using data compression. The FS300e also supports a proprietary format called HCF (high-capacity format) that increases the capacity of a DC-2120 tape to 300MB with compression enabled. This format is not compatible with the QIC-80 standard.

FACT FILE

Tallgrass Technologies Corp., 11100 W. 82nd St., Lenexa, KS 66214; 800-825-4727.

Tallgrass FS250e
List Price: With standard cabling, one formatted tape, *FileSecure*, $825; internal tape drive, $575.
Requires: 384K RAM, hard disk, floppy disk drive controller, DOS 3.1 or later.

Tallgrass FS300e
List Price: With standard cabling, one formatted tape, *FileSecure*, accelerated controller, $1,195; internal tape drive, $995.
Requires: 384K RAM, hard disk, DOS 3.1 or later.
In Short: High prices characterize both the Tallgrass FS250e and the Tallgrass FS300e, but so does a generous two-year warranty. The FS300e offers a proprietary format that increases the capacity of a DC2120 tape to 300MB; unfortunately, the unit also experienced errors with preformatted tapes from the company The FS300e, which includes an accelerated controller bested its sibling on our standard-configuration tests but provided only average performance.

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An internal version of the FS250e sells for $575; the internal FS300e offering costs $995.

SOFTWARE OFFERING

FileSecure, Version 1.52, is included in the price of each unit. This software is menu-driven and straightforward. *FileSecure* is a DOS product; a Microsoft Windows alternative is not available, and Tallgrass does not plan to offer one.

The software offers file-by-file backup and restore, with or without compression and verify. You may also format or erase a tape, among other options. You select or tag directories and files from a directory tree diagram. If desired, you may back up only modified files. If your drive is larger than the capacity of the tape, you may restore to multiple tapes. The software makes excellent use of prompts as you prepare to back up or restore data.

If you want to automate backups, you can do so through the scheduled backup feature. To enable this feature, you simply fill out an event table with the type of backup you want, times, and dates. One problem with the software occurred after quitting: The current *FileSecure* screen was not erased. This was not a grievous fault, but continuously typing CLS at the DOS prompt can get annoying.

The FS300e's proprietary format increases the capacity of a DC-2120 tape to 300MB with compression enabled.

To its credit, the Tallgrass FS250e did not experience errors when using a preformatted tape from 3M. However, the same could not be said for the FS300e tape drive, which did experience errors with preformatted tapes. No errors occurred when tapes formatted by the FS300e were used in the drive.

PERFORMANCE ISSUES

When tested in their standard configurations with verify on, the accelerator-equipped FS300e was substantially faster than the FS250e. The FS250e managed a timing of 28 minutes 48 seconds on the Full Disk Backup test, while the FS300e made it in 16 minutes 15 seconds. The Directory Backup scores were 16 minutes 45 seconds and 9 minutes 37 seconds, respectively. The Full Disk Restore test forced the FS250e to a dismal 30 minutes 5 seconds, while the FS300e pulled in a faster 19 minutes 38 seconds (which was still slow when compared with some other, nonaccelerated drives in this roundup). Directory restores were 17 minutes 15 seconds on the FS250e and 11 minutes 2 seconds on the FS300e. The FS300e managed to restore a single file in slightly over 2 minutes; the FS250e took a little over 3 minutes.

Not surprisingly, when the FS300e was tested with verify off, it received even better scores on the Full Disk Backup and Directory Backup tests than it did with verification on. However, when compared with the scores of other accelerator-equipped entries tested with verification

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PERFORMANCE TESTS

PC Magazine Labs' tests of tape drives in their standard configurations showed fairly large performance differences among these 13 competitors. Some of the differences result from the various ways data verification is used, if it is even available. The presence of accelerated controllers in the units' standard configurations is another factor. Our tests also show that turning data verification off and/or installing an accelerated controller can significantly increase the backup performance of these tape drives.

WHAT THE NUMBERS MEAN

STANDARD CONFIGURATION, VERIFICATION ON

When we tested the 13 tape drives in their standard configurations, we found fairly large performance differences. Some of these depend on whether verification is available only in the backup process (as with most drives) or whether it is available for both backup and restore.

The fastest unit on almost all of our tape backup performance tests of units in their standard configurations was the Everex Excel 120F. However, data verification is not supported by Everex Systems' *FTape* software, which makes its results incomparable to the others. While the Excel 120F's speed is impressive, in many situations it is advisable to operate a backup system with verification enabled; this ensures data integrity, even though it results in slower performance times (for backup and, if supported, for restore).

Among units with verification, the Irwin AccuTrak Plus A250E was the speediest tape backup system on three out of four standard-configuration tests. The AccuTrak Plus performed some backups over 4 minutes faster than most of the competition, and it restored at least 2 minutes faster than the other products on the Full Disk Restore and the Directory Restore tests. The AccuTrak Plus, however, may have benefited from the use of its accelerated controller, which was shipped with the tape drive (Irwin Magnetic Systems offers a 500-kilobit-per-second controller but did not supply it for this review). Note that the AccuTrak Plus was only 28 seconds faster than the next closest tape drive—the Alloy Retriever/250ce—on the Single File Restore test.

Because of hardware incompatibilities with our test-bed, the Tallgrass units were tested in nonconcurrent I/O mode. Tallgrass reports that data verification requires more time to complete in this mode than in concurrent I/O mode. Even so, the FS300e boasts some of the speediest Full Disk Backup and Directory Backup scores among the units tested with verification enabled; like the AccuTrak Plus, it may owe part of its speed to its accelerated controller.

The Alloy and Micro Solutions units turned in similar results on the Full Disk Backup, Full Disk Restore, Directory Backup, and Directory Restore tests. Both use modified versions of the *QICstream*, as well as the Archive mechanism. Their paths diverged on the Single File Find test, where the Micro Solutions was one of the slowest performers. The Alloy also bested it on the Single File Restore test.

The Mountain FileSafe External 8000Plus uses data verification for all writes to tape and writes to disk. This is reflected in its slower Full Disk Restore and Directory Restore times on the standard-configuration tests, since more time is required to verify the data after each write in the restore process. The Mountain employs a unique *bit-for-bit* verification of all backups and restores, comparing the original data bit for bit to the copy that the *TD4000* tape software is about to make.

In general, the COREtape Light produced the slowest backup performance. It required 40 minutes 1 second to back up our 52MB hard disk, and 27 minutes 9 seconds to back up the 30MB subdirectory. Its Full Disk Restore test performance (which most likely did not have verification enabled) was much better, but slower than most. Unfortunately, the COREtape Light could not successfully restore one directory in the 30MB subdirectory tree. Core International was unable to solve the problem.

STANDARD-CONFIGURATION TESTS (VERIFICATION ON)

Elapsed Time (minutes:seconds)
Lower scores represent better performance.

	Full Disk Backup	Full Disk Restore	Directory Backup	Directory Restore	Single File Find	Single File Restore
Everex Excel 120F *	14:55	12:04	08:54	06:25	06:04	00:35
Tallgrass FS300e **	16:15	19:38	09:37	11:02	00:49	02:04
Irwin AccuTrak Plus A250E **	21:08	11:15	11:04	05:20	00:09	00:58
Micro Solutions Backpack Tape Drive	26:45	14:16	15:43	08:20	04:18	02:04
Alloy Retriever/250ce	27:02	13:20	16:13	08:00	02:28	01:26
Tallgrass FS250e	28:48	30:05	16:45	17:15	01:18	03:08
Colorado Memory Systems Jumbo 250 External	29:04	13:44	17:02	08:25	N/A†	02:35
Mountain FileSafe External 8000Plus	31:00	29:10	14:01	13:21	00:47	03:17
Wangtek E3080PK	31:08	13:26	17:45	07:52	01:23	02:11
Maynard ArchiveXL 5580e Tape Backup	31:55	13:19	15:48	07:54	01:50	03:02
Tecmar MiniVault 250	32:38	19:23	18:23	08:15	03.05	04:28
Summit Express SE250 Tape Backup	35:05	15:13	19:24	07:24	01:09	02:02
COREtape Light	40:01	24:38	27:09	N/A†	01:19	02:46

* This product was tested without verification. ** This product was tested with an accelerated controller.
N/A†—Not applicable: For this product, the time required to find a file is included in Single File Restore.
N/A†—Not applicable: This product was unable to restore one directory in the 30MB subdirectory tree.

ACCELERATOR INSTALLED, VERIFICATION OFF

Eliminating data verification and installing an accelerator board (where available but not already installed) significantly increases performance. The largest performance increases were registered on the Full Disk Backup test, where we saw as much as a 27-minute improvement over the nonaccelerated result with the same tape drive. That particular leap in performance was produced by the Summit Express SE250 Tape Backup.

In each case where we were able to test the same unit with and without an accelerator board (that is, in all cases except for the AccuTrak Plus and the Tallgrass FS300e), we saw a time reduction of 58 to 77 percent over the nonaccelerated results on the Full Disk Backup test. On the Directory Backup test, we measured reductions in the range of 6 percent to 72 percent.

In general, the Full Disk Restore and Directory Restore performances were hardly affected by the presence of an accelerator or the disabling of verification. With verification off, the fastest accelerated controller/tape drive system was the Colorado Memory Systems unit, which turned in a speedy 7 minutes 54 seconds for a full disk backup and 5 minutes 15 seconds for a directory backup. This was closely followed by the Wangtek and Summit systems; their Full Disk Backup scores were 8 minutes 5 seconds and 8 minutes 13 seconds, respectively, and their Directory Backup scores were 5 minutes 1 second and 5 minutes 12 seconds, respectively. Their Restore times, average for this class, were almost unchanged from the standard configuration results for both units.

HOW WE TESTED

We tested all the tape drive systems on a Compaq 386/25e with 8MB of RAM, a 310MB ESDI hard disk, and a VGA display. All hard disks were formatted using Compaq DOS 5.0 and partitioned into three logical drives (C:, D:, and E:). All system software and QIC tape backup software were installed on the C: drive.

The file system that each tape drive had to back up and restore was created with the PC Magazine Labs Data Generator (which creates sequential and random files in both binary and ASCII format) and was installed on the D: drive. The file structure consisted of several hidden files, two hidden subdirectories, read-only files, 0-byte files, and two 7MB files (typical of high-resolution color bitmap files). The directory structure consisted of 14 subdirectories off the root of the D: drive, with two of the subdirectories going seven levels deep. The total file structure was 52,355,072 bytes, as reported by DOS CHKDSK. All restores were performed to the E: drive, which we reformatted before each restore to avoid erroneous data-capacity readings.

We had installed the backup software for each tape system using the default settings as suggested by the manual or the installation software. We manually configured all software to use data compression whenever possible. For our first set of tests, verification was turned on, and for the second set, it was disabled.

We performed these tests in the foreground using the provided software's program shell. All timing was done manually with a digital stopwatch; the timings began with the last key press to start a procedure and ended when keyboard control was returned to the program shell. Times are reported in minutes and seconds.

The first set of data (on the facing page) indicates the products' performances in their standard configurations. For the Tallgrass FS300e, the standard configuration includes the accelerated controller; the controller can be set to run at the standard rate of 500 kilobits per second, but we didn't test the tape drive in that mode since it is really recommended only for PC-XT computers. The Alloy Retriever/250ce and the Irwin AccuTrak Plus A250E do not include controllers in their basic configurations; they are extra-cost components required for operation on our test-bed. Alloy Computer Products offers only a standard 500-kilobit-per-second controller, while Irwin Magnetic Systems supplied only its accelerated controller for our review. For these products, we used verification whenever available (including the restore procedure). The Everex Excel 120F does not have verification capabilities for its backup or restore operations.

The second set of data (this page) reports the performance of each product that came with an accelerated controller (whether standard or optional), when tested in accelerated mode and with verification disabled. We do not report Single File Find or Single File Restore test results in this context; in almost all cases, the disabling of data verification combined with the presence of an accelerator did little to change the performance the tape drives achieved in their standard configurations.

■ The **Full Disk Backup** test measures the time it takes to perform a file-by-file backup of the disk's entire contents. Typically, this is the first function performed after installing the tape drive system.

■ The **Full Disk Restore** test measures the time it takes to perform a file-by-file restore of the tape's contents after the Full Disk Backup test has been performed. This function is typically performed after replacing a faulty hard disk with a new one.

■ The **Directory Backup** test measures the time it takes to perform a file-by-file backup of one 30MB directory tree. This simulates periodic selective backup of program and data files.

■ The **Directory Restore** test measures the time required to perform a file-by-file restore of the tape's contents after the Directory Backup test has been completed. This procedure can usually be used to recover archived program and data files.

■ The **Single File Find** test measures the time it takes to locate a single file among the contents of a backup tape.

■ The **Single File Restore** test measures the time it takes to perform a single file restore after the Single File Find test has been performed. This time is important, since many real-world situations revolve around replacing a single lost or corrupted file.

ACCELERATED TESTS (VERIFICATION OFF)
Elapsed Time (minutes:seconds)
Lower scores represent better performance.

	Full Disk Backup	Full Disk Restore	Directory Backup	Directory Restore
Colorado Memory Systems Jumbo 250 External	7:54	9:38	5:15	5:58
Wangtek E3080PK	8:05	13:16	5:01	7:47
Summit Express SE250 Tape Backup	8:13	13:40	5:12	7:16
Tallgrass FS300e	9:14	19.40	5:39	11:00
Irwin AccuTrak Plus A250E	9:30	9:40	6:20	5:07
Mountain FileSafe External 8000Plus	11:23	9:18	7.22	7:22
Tecmar MiniVault 250	13:32	20:48	7:48	8:48

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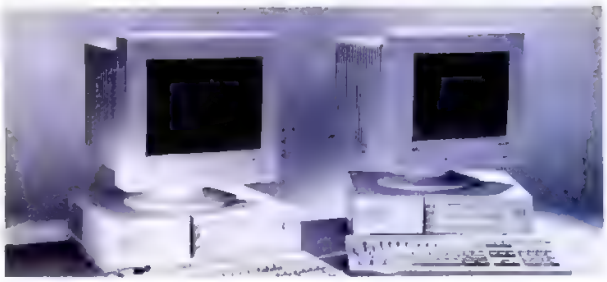

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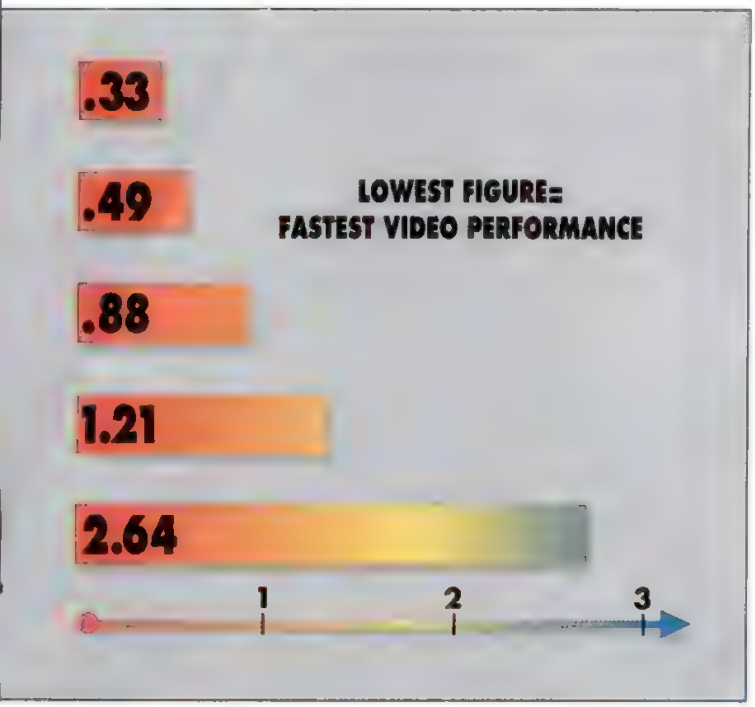

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Test performed by
Computer Market Research, Ltd

turned off, the FS300e's Restore scores are not impressive.

The company provides technical support from 8:00 A.M. to 6:30 P.M. (C.S.T.) weekdays at an 800 number.

The Tallgrass FS250e is able to work flawlessly with preformatted tapes, but it gets lower grades for price and performance. The Tallgrass FS300e offers better performance than its sibling and easy installation, but it is substantially more expensive; it's one of the most expensive drives reviewed, even when you take into account the additional cost of other systems' optional accelerators. In our evaluation, it also had problems with preformatted tapes. There's certainly a lot to like about the unit, including its straightforward software, but not quite enough to justify the price.

TECMAR INC.

Tecmar MiniVault 250

BY ED PERRATORE Tecmar will tell you its $699 Tecmar MiniVault 250 is marketed primarily toward the home and small-business PC user, particularly because a common software interface with the vendor's higher-end backup products makes for an easy upgrade later. Don't let this strategy fool you: This recently shipped product, with a few exceptions, offers enough features to compete with more expensive units reviewed here for a long time to come. The one area it could improve on is performance.

The external version of the MiniVault 250 includes in its base price *MiniVault Operating Software,* Version 1.3, a floppy-disk-drive ribbon interface cable (with power connecter and internal floppy-controller-to-rear-port connector), and one 3M-made 120MB cartridge. Formatted tapes sell at $99 per two-pack.

If your existing floppy disk drive controller does not support 500-kilobit-per-second transfer, or you wish to rise to a full 1-megabit-per-second clip, you must purchase the $229 Tecmar-made 813421 accelerated controller ($249 for MCA systems). An internal version of the drive is available for $519.

Wangtek, Tecmar's sister company,

Tecmar MiniVault 2
Tecmar Inc., 6225 Co
44139; 800-624-8560
List Price: With standar
formatted tape, *MiniVault*
$699; internal tape drive, $
accelerated controller, $229
accelerated controller board,
Requires: 430K RAM, hard di
drive controller, DOS 3.0 or late
In Short: The Tecmar MiniVault
well-thought-out software that pro
as well as file-by-file backups. The
the lowest, and the system does not
great speed. However, its flexibility o
its average (or slower) performance, a
two-year warranty is a welcome extra.

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PC WEEK LABS ANALYST'S CHOICE
Oct. 15, 1990
PST-160

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Feb., 1991
PST-160

VALITEK

actually makes the drive mechanism; Wangtek sells the same drive/interface package for $30 less but with *Central Point Backup,* which will also work with the MiniVault 250. Keep in mind, however, that Tecmar's software (like any proprietary offering) was optimized specifically for the drive. As with the Wangtek unit we reviewed, the interface is too short to reach the motherboard-based floppy disk drive controller on the test-bed Compaq system. This could present problems for any user who owns that system or one with a similarly positioned floppy disk drive controller connector.

The MiniVault 250 is not a QIC-80–certified drive, according to the QIC organization's testing outfit. Tecmar expects tapes to be interchangeable with any tape drive/software that follows the QIC-80 standard, though.

VERSATILE OPTIONS

The product's software is versatile and permits image as well as file-by-file backups and restores. You won't find password protection, but you can view the size of files before tagging them for backup. A tree layout makes tagging easy, and if you know what you want from a selected backup, you can easily tag a directory and all files and directories that lie beneath.

Restore options are plentiful as well, although the product makes you go out of your way if you want to change your target destination. For this, you must choose a separate menu option, Directory Utilities; this is unlike products using versions of Archive's *QICstream* from vendors such as Alloy Computer Products, Micro Solutions, and Maynard Electronics.

One nice feature is Tecmar's use of a swap file, which the software can create on a user-specified drive (such as a hard disk or RAM drive) when it has more directory information than it can store in memory. Use of a swap disk can prevent errors if you're backing up a large number of files.

Test results for the MiniVault 250 in its standard configuration were basically on the slow side of average. Full Disk Backup took 32 minutes 38 seconds, while restoring the same data required 19 minutes 23 seconds. Directory backup necessitated 18 minutes 23 seconds, and the corresponding restore took 8 minutes 15 seconds. Restoring a single file took longer than any other system—4 minutes 28 seconds.

Among its peers equipped with an accelerator board and with verification turned off, the MiniVault 250 with its 813421 accelerator still came in as one of the slower units, taking 13 minutes 32 seconds to back up a full disk and 20 minutes 48 seconds to restore it. The Directory Backup test time was also slow.

Tecmar's 24-month parts-and-labor warranty with unlimited, toll-free support (Monday to Friday, 7:00 A.M. to 8:30 P.M. E.S.T.) includes six months of 48-hour turn-around if you run into a problem. The company also operates a BBS.

If you need password protection, great speed, or a drive that has passed the QIC-80 certification tests, then the Tecmar MiniVault 250 is not for you. But it is suitable for just about everyone else. The flexible software outweighs the unit's

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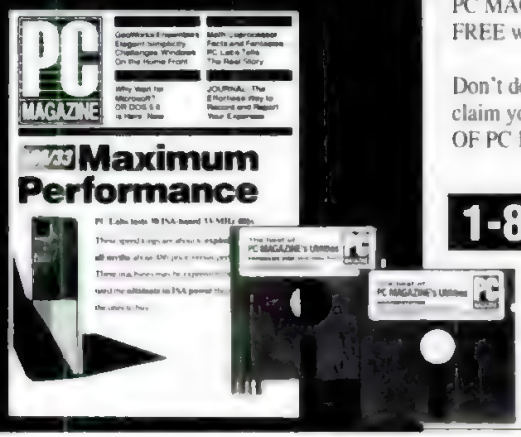

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average (or slower) performance, the warranty is one of the longest available in this product category, and the price, while not the lowest we saw, is reasonable in the light of what you get.

WANGTEK INC.

Wangtek E3080PK

BY JOSEPH DESPOSITO The Wangtek E3080PK tape drive comes in at a retail price of $699; the cost includes the well-known *Central Point Backup* software and one preformatted tape. While the inclusion of both a DOS and a Microsoft Windows version of the backup software is welcome, the drive did present us with some problems during testing.

As with the Tecmar MiniVault 250, installing the Wangtek in a system such as PC Magazine Labs' Compaq Deskpro 386/25e test-bed creates a problem. The interface, which is simply a connector, is not designed for a system like the Compaq: It's much too short to reach the floppy disk controller embedded on the motherboard. Any PC with a floppy connector on the motherboard at a distance of more than about 6 inches from the opening at the back will present the same installation problems. Wangtek's optional $39 wide-cable connector should take care of the problem, but we didn't receive that product for this review.

Also, this interface has an odd way of acquiring power for the tape drive: Like the Tecmar MiniVault 250, the Wangtek has an interface with strands of the ribbon cable cut and routed to a power connector.

Wangtek sells an optional $199 Thunderbolt controller, whose maximum transfer rate is 1 megabit per second. You slip the card into an expansion slot and attach a power supply connector to it. For either installation, a cable is provided to connect the tape drive to the interface or controller. Tapes slide three-quarters of the way into the drive and can be pulled out by hand.

SOFTWARE STRAITS

Central Point Backup, Version 7.1, for both DOS and Microsoft Windows is included in the price of the unit (this is the same software offered with the Summit Memory Systems tape drive). The Windows version offers the same choices as the DOS version.

The software offers file-by-file backup and restore, with or without compression and verify. As noted in the Summit review, the software offers three types of compression options. When preparing to back up files, you select or tag directories and files from a directory tree diagram. If desired, you may back up only modified files. If you want to automate backups, you can do so by filling out a schedule table.

You cannot simply format a blank tape; instead, the software automatically formats it before performing a backup. However, error messages such as "tape requires formatting" imply that you can select a formatting command.

The Wangtek E3080PK produced errors when using tapes Wangtek preformatted using *Central Point Backup;* other drives in this review likewise had problems using preformatted tapes. During our evaluation, the computer also hung up after formatting a tape; Central Point and Wangtek are aware of problems with the formatting portion of the software and claim that they now have a fix to send out to any user requesting it. To solve these problems during our evaluation, we either pressed Escape or rebooted.

Without the Thunderbolt accelerator card, the Wangtek E3080PK's Full Disk Backup time was on the slow side of average, at 31 minutes 8 seconds, as was its Directory Backup time of 17 minutes 45 seconds. Restore times were more competitive, at 13 minutes 26 seconds for the full disk and 7 minutes 52 seconds for the directory. Restoring a single file took 2 minutes 11 seconds.

With the Thunderbolt installed and verification turned off, the Wangtek E3080PK pulled in excellent times on the Full Disk Backup and Directory Backup tests, and midrange scores on the Full Disk Restore and Directory Restore tests. Following a trend, its scores on the restore tests done without the verification option and using the accelerator were not much different from its scores without the accelerator installed and with the verification option turned on.

> *With the Thunderbolt card installed and verification disabled, the Wangtek pulled in excellent times on the Full Disk Backup and Directory Backup tests.*

An internal version of the drive is available for $479. Wangtek warrants the Wangtek E3080PK tape drive for a period of one year. Wangtek also operates a technical support BBS (805-582-3370). Toll-free technical phone support is available from 6:00 A.M. to 6:00 P.M. (P.S.T.) weekdays.

The Wangtek E3080PK's Thunderbolt controller shows potential for speeding up backups, and *Central Point Backup* for Windows is a good feature for those working in that environment. But with recurring tape errors, the Wangtek E3080PK is hard to recommend. ■

FACT FILE

Wangtek E3080PK
Wangtek Inc., 41 Moreland Rd., Simi Valley, CA 93065; 800-992-9916
List Price: With standard cabling, *Central Point Backup* for DOS and Microsoft Windows, $699; internal tape drive, $479; Thunderbolt accelerated controller, $199.
Requires: 512K RAM, hard disk, floppy disk drive controller, DOS 3.0 or later, Microsoft Windows 3.0 or later.
In Short: Like the Summit unit, the Wangtek E3080PK includes the versatile *Central Point Backup* both for DOS and for Microsoft Windows. However, we had problems using preformatted tapes from the company, and the computer hung up after formatting a tape prior to backup. Performance on our standard-configuration tests was on the slow side, but the Wangtek pulled ahead to achieve excellent backup times on our tests with accelerators installed and verification disabled.

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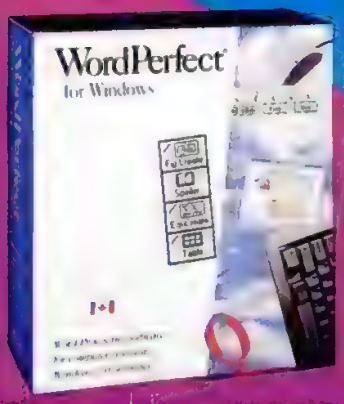
THE BIG ★★★ 3



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Edward Mendelson
PC Magazine, (June 25, 1991)

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TRUE COLOR PERFORMANCE AT GRAY SCALE PRICES:

Nine Desktop Scanners That Do It All

Today you can buy a color scanner for the same price that gray-scale models fetched only a year ago. This puts real-world images into the grasp of mainstream presenters as well as cost-conscious artists. Add these devices to the growing toolbox of sophisticated graphics software and hardware available, and you've turned your once graphically backward PC into a machine that resides on an artistic plane close to that of the exalted Mac.

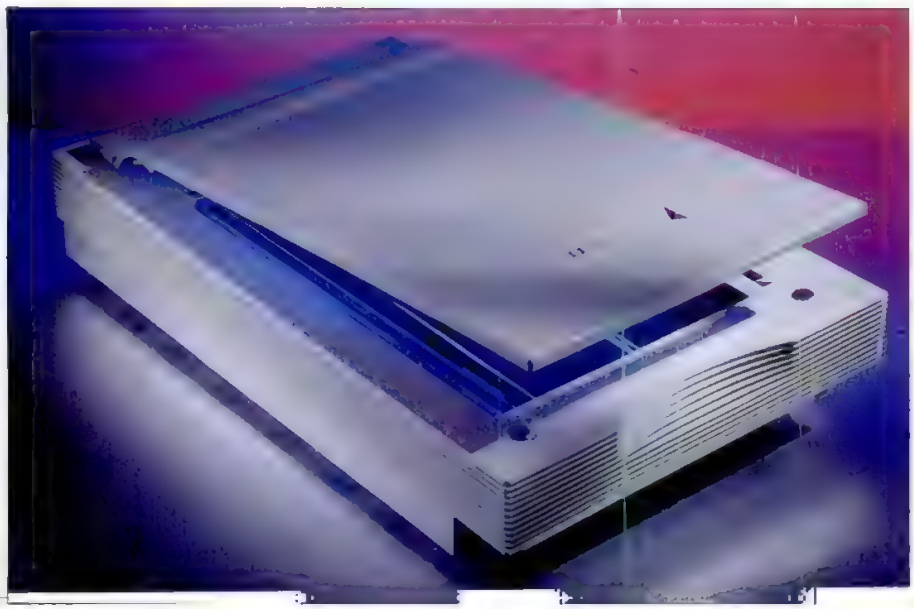


PHOTO: CHRISTOPHER GOULD

by Mitt Jones

Many factors have at last combined to bring color scanners—and the attention-grabbing images they afford—to the PC mainstream. For an investment of $1,500 or less, documents can be adorned with eye-grabbing color images; on-screen presentations can mercifully transcend beyond the bullet chart and drop-shadowed bar.

To the uninitiated, $1,500 may sound expensive, but two facts should help put the current pricing into a more pleasing perspective. First, color flatbed scanners now sell at prices similar to those exacted

OUR CONTRIBUTORS

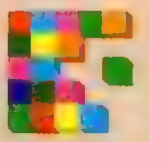
Mitt Jones is a contributing editor of *PC Magazine*.
Kellyn Betts and **Greg Pastrick** are free-lance writers and frequent contributors to *PC Magazine*.
Steve C. M. Chen is a free-lance writer and president of CCM Consulting.
James Karney is a computer and information systems consultant.

SUITABILITY TO TASK

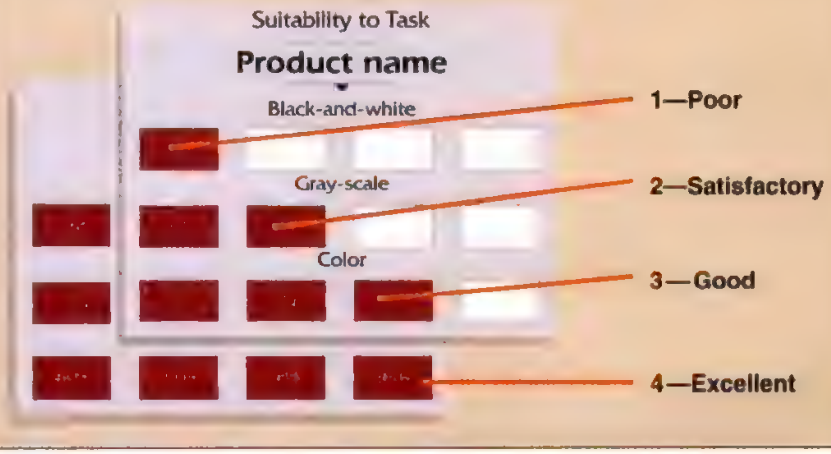
Today's flatbed scanners are multitalented. Their suitability to the wide variety of tasks they can handle breaks down into two main components: image quality and speed. By nature, graphics reproduction emphasizes image quality; speed becomes a secondary issue.

Black-and-white evaluates the output quality of the scanner's black-and-white (line-art) mode. The score reflects both the sharpness of the unit's line-art scans and the variety and resolvability of its dithered scanning modes.

Gray-scale evaluates the scanner's suitability for scanning photographs and other continuous-tone images in gray scales. The score reflects the dynamic range and clarity of the scanner's gray-scale output and the quality of its bundled image-editing software.



Color evaluates the scanner's suitability for scanning images in color. The score takes into consideration the dynamic range, clarity, and color accuracy of the unit's color output, as well as the quality of the image-editing software.



a year ago for comparable gray-scale scanners, and only a few hundred dollars higher than those of gray-scale units today. Second, these scanners can do everything their less colorful counterparts can do, and they do it as well or better; that includes scanning text, line art, and black-and-white photographs.

Once you've justified $1,000 or so for a gray-scale scanner, the step up to color makes sense. Whether your desktop publishing needs include persuasive reports, eye-catching fliers, or impressive catalogs, a color scanner vastly increases the realm of possibilities. Those interested in creating multimedia presentations and image databases will find a color scanner invaluable.

Here, in the first roundup of flatbed color scanners ever to appear in *PC Magazine*, each of the nine offerings reviewed supports scanning at "true" color depth: 8 bits per color, or 24 bits per pixel, for a total of 16.8 million possible colors. Each also scans at a resolution of at least 300 dots per inch (dpi). Finally, each bears a list price of less than $4,000, with several popular models selling at street prices less than $1,500.

The manufacturer of one notable scanner that met our selection criteria—the $2,195 Sharp JX-320—failed to provide an evaluation unit in time for this review. For a look at the Chinon DS-3000C Color Scanner, which boasts a list price under $1,000 but lacks the 24-bit color and 300-dpi resolution required for inclusion in this roundup, see the sidebar "Marching to a Different Drummer."

Most of these products offer legal-size scan beds, but they fall short of providing the color accuracy or image resolution necessary for commercial-quality reproduction. For that, you'll need something along the lines of Optronics' $65,000 ColorGetter, which scans at 2,000-dpi resolution with up to 36 bits of color information per dot—for a total of about 69 billion possible colors. With desktop access to digital color images, however, an individual, small business, or DTP department on a limited budget now has the option of taking on substantial parts of the job, passing on to service bureaus, print shops, and other ancillary professionals the tasks they aren't equipped to handle.

In some instances, this means using a desktop scanner simply to provide the necessary images for full-color mockups and electronic layouts, leaving the final scan of images to a service bureau. In cases where image quality is secondary to budgetary concerns but 300-dpi output just won't do, a growing number of users are finding that an image scanned on their own desktop will provide fairly impressive results if turned over to a professional for processing and printing.

Of course, not everybody needs professionally printed output (or needs printed output at all). Scans from desktop machines are perfectly adequate for many internal publications, PC-based faxing, image databases, and display-only applications.

GAINING GROUND

Any discussion of why color desktop scanners have recently become affordable—and why scanner vendors didn't introduce them long before—will resemble the proverbial debate over the chicken and the egg. The development has surprisingly little to do with momen-

INSIDE A COLOR SCANNER

by James Karney

A scanner serves as the eyes of a personal computer. Containing thousands of cells that work like the compound eye of a bee, it can see photographs, capture artwork, and read hard-copy text (with the appropriate software).

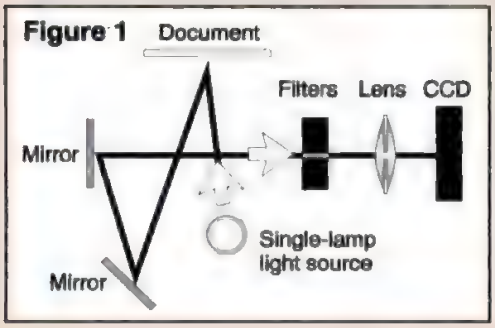


Figure 1

Scanners look and operate much like personal copiers and share much of the same technology. Just place a sheet of paper on the glass (or *platen*) and push a software button, and the scanner copies your image to the computer. As with copiers, the outward simplicity is deceptive.

Inside the scanner is a linear array called a *charge-coupled device* (CCD), which is composed of about 2,600 photosensitive cells or *elements*. In most desktop scanners the CCD is only about an inch square and is fixed in place. A light bar moves across the object being scanned (the target), and the light is reflected to the CCD by a system of mirrors.

Each cell produces an electrical signal proportional to the strength of the reflected light that hits it. The signal—which represents one pixel in the original image—is converted into a binary number and sent to the computer. Darker portions of the target reflect less light and are given lower numbers.

Early scanning devices—1-bit scanners—were limited to one value per pixel, either on or off, which represented black or white. Most desktop scanners today have CCDs that can differentiate 256 shades of gray or levels of brightness. That is about the same brightness range as a black-and-white photograph and roughly twice what the human eye can distinguish.

The resolution of a scanner is measured in dots (pixels) per inch (dpi). This is a fixed number based on the number of cells in the array and the total area scanned. For example, an array with 2,590 cells covering 8.5 inches gives a resolution of 300 dpi. The smaller the area, the better the resolution. Most color flatbed scanners today have resolutions of 300 or 400 dpi.

Many scanners can produce lower resolutions with the proper software. Some offer increased resolution on one axis by taking readings more often as the light bar moves. For instance, a 300-dpi unit taking readings every $^1/_{600}$ inch yields a 300- by 600-dpi image.

Interpolation is another method of improving resolution—mathematically. An algorithm is used to calculate the value of a pixel placed between two that are actually scanned. If one of the pair were read as 8 and the other as 12, the formula might place the interpolated dot at a value of 10. The success of the final image depends on the type of material being scanned.

NOT ALL BLACK AND WHITE

Since CCDs capture brightness levels, it makes sense that they can be found in gray-scale scanners, which are used for reproducing both continuous-tone and line-art originals. But how does a scanner capture color with the same CCD?

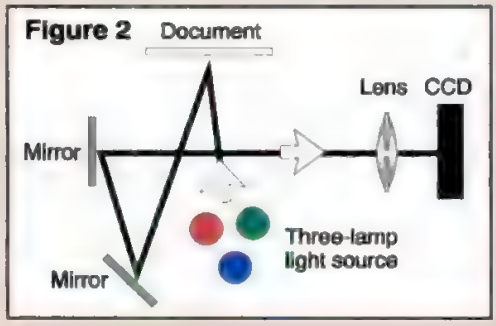


Figure 2

The answer: by creating three separate versions of the image, one for each of the three primary colors of light reflected by the target. Most color scanners do this in three passes: One pass with a red filter records the red component; a second pass with a green filter records the green light; a final pass with a blue filter records the blue (see Figure 1). "True-color" scanners, like the ones reviewed here, record 8 bits of data for each pass, for a total of 24 bits of data per pixel. The result is a composite image with 16.8 million possible colors (2^{24} colors).

There are other approaches. Color scanners like the Epson ES-300C have three different-colored lights, which flash in sequence as they travel down the platen (Figure 2). The third method for creating color scans is to use three CCDs, each collecting information about only one color. The HP ScanJet IIc uses a twin-lamp light bar, two sets of filters, and a three-stripe CCD to allow single-pass scanning (Figure 3).

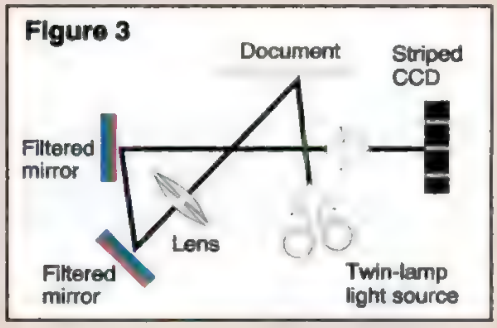


Figure 3

There is no clear advantage to any one technique. None of the vendors can promise that the data gathered by their products for the three different colors will be aligned exactly (a process called *registration*). Beyond the problem of regular light-bar movement, many units have to start and stop as the amount of data generated exceeds the computer's ability to process it. If they are a pixel or two off, the results will be a little fuzzy. Significantly more misalignment would be unacceptable. But none of these units are so bad that the results ever resemble a 3-D movie without the glasses. ■

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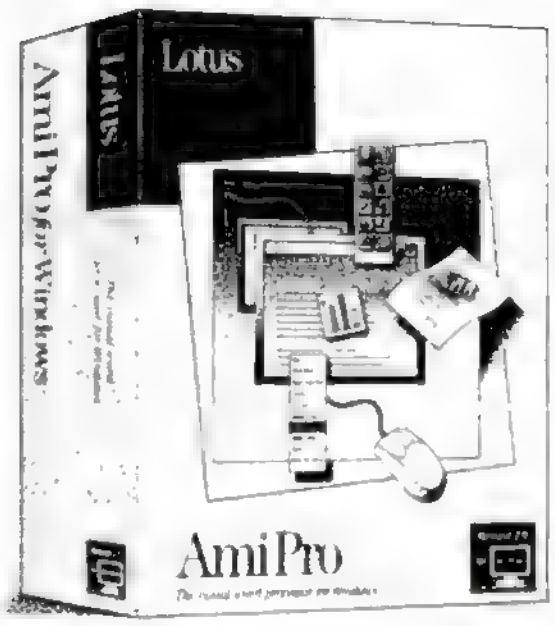

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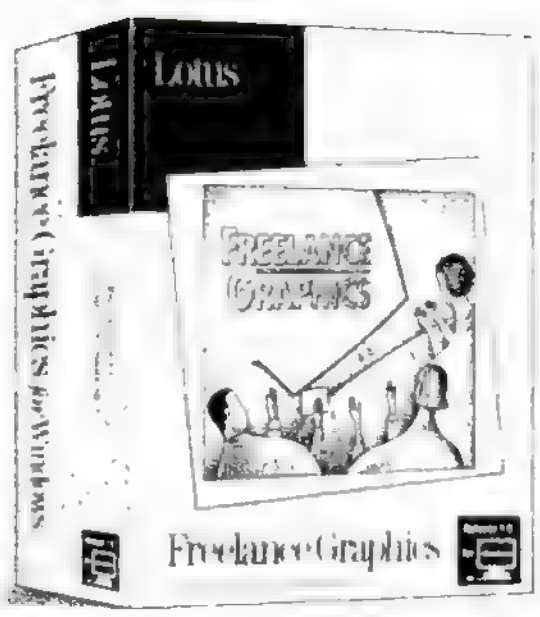

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CIRCLE 282 ON READER SERVICE CARD

tous strides in scanner technology; the *charge-coupled device* (CCD) technology used in these scanners differs little if at all from that used in gray-scale scanners for years (see the sidebar "Inside a Color Scanner"). Credit goes more to the PC's evolution toward a graphics-minded platform, and to user demands that both drove and resulted from this growth.

It would be difficult to overlook the phenomenal gains the PC has made over the years in processing speed, memory, and hard disk storage, areas on which any graphics-intensive application places heavy demands. Developments in display-system technology are another important part of the picture.

To use a scanned image effectively, you must be able to manipulate it to ensure that it will print with the desired appearance. For this sort of image processing, you need a display system capable of rendering the image at least somewhat accurately, so that you can see what adjustments are necessary. With 16 simultaneous colors and 4 shades of gray, the EGA standard was virtually useless for this purpose. The 256-color mode of the VGA standard was an improvement, but its 320-by-200 resolution was still a problem. With the advent of the Super VGA standard, which supports 256 simultaneous colors at 640-by-480, the PC begins to be an acceptable platform for image editing. Now, reasonably priced adapters offering 32,000, 64,000, or even 16.8 million simultaneous colors—along with the eventuality of a device-independent color-matching standard—hold the greatest promise.

The widespread acceptance of Microsoft Windows 3.0 has played an equally important role, or possibly a greater one. If users need a system at least reasonably well suited to their needs, developers need a platform that will accommodate their products—a platform that boasts a user base substantial enough to warrant writing to it.

Windows has helped tremendously in every regard. Having made the investment in a system appropriate for running Windows, millions of PC users now find they can acquire relatively sophisticated image-handling capabilities at a relatively low additional cost. Vendors find themselves with enough buyers to bring down their production costs per unit—and with a target market that is large enough to make selling low an attractive proposition.

MARCHING TO A DIFFERENT DRUMMER: The Chinon DS-3000 Color Scanner

by James Karney

If you can't afford a 24-bit color flatbed scanner, want to step up from a gray-scale hand-held unit, or just want something different, the Chinon DS-3000 Color Scanner may meet your needs. Its overhead design allows 12-bit color scans at 75 dots per inch (dpi), and 8-bit "halftone" (not true gray-scale) or 1-bit line-art scans at 300 dpi.

While the DS-3000 is not in the same league as the color flatbeds reviewed for this issue, we felt the unit was worth looking at as a low-end alternative.

Unlike flatbed scanners, the DS-3000 has no internal light source or filter pack. Instead, all of the imaging components are mounted in a head placed above the scanning surface. A mirror in the head is rotated during the imaging process, reflecting the data to the CCD (charge-coupled device) sensors. This arrangement has advantages: You can scan three-dimensional objects (if they are not too tall), and you have complete control over the light falling on the target. But you have to contend with a shadow cast on the item being scanned, and the depth of field for 3-D objects is limited to about 1 inch.

The scanner is controlled with a custom bidirectional parallel card. Chinon America bundles a two-light set with the DS-3000; the set is attached to the sides of the scanner and provides bright, even, white light for flat objects. OCR users will get good results with the included *WordScan* software. We found that fabric samples showed up well when we dropped the light source to increase shadows, but it took some skill (and extra lights) to obtain satisfactory results for most 3-D targets.

NOT QUITE A RAINBOW

Although the DS-3000 is billed as a color scanner, its 12-bit (4,096-color) images are not suitable for much more than simple business presentations. The proprietary *ColorSet* software operates under Windows and allows prescanning, setting the scan area, and adjusting brightness, contrast, and HSV (hue, saturation, value) settings. You can also perform image corrections such as sharpening and softening, or convert an image to gray-scale and adjust the color palette. *ColorSet* works only with a 256-color Super VGA Windows driver.

If you want to perform a color scan, you must manually change the colors of a filter pack that is placed over the sensors. The software prompts you to move a tab after each of the first two passes. Chinon claims a 24-second full-page scan for gray scale and 90 seconds for color. We found that 40 seconds was normal for gray-scale performance. With the delays for writing to disk, changing filters, and resuming scanning, we found that color scans took about 3 minutes. A DOS-based program is provided for handling black-and-white scans from a simple menu. There are no correction features, so most users will want to use *ColorSet* for most operations.

In general, the DS-3000 is a good compromise for those who don't require true 24-bit color, need an inexpensive overhead scanner for small 3-D objects, or have only occasional, black-and-white imaging requirements. *WordScan*, a very good program, makes the DS-3000 a cost-effective solution for low-volume OCR work. Anyone needing a higher level of automation, more volume, or true color should look a little further. ■

Chinon DS-3000 Color Scanner, Chinon America Inc., 660 Maple Ave., Torrance, CA 90503; 800-441-0002. **List Price:** $995; other configurations, $695 to $1,195. **Requires:** Super VGA display (256 colors), DOS 3.0 or later.

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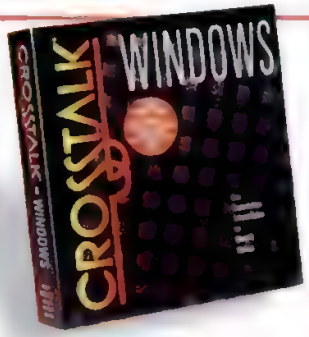

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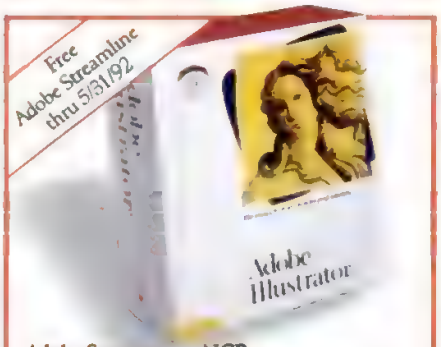

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4214 ▣WordPerfect Office PC ..... 89.
3804 ☐WordPerfect 5.1 ..... 265.
3494 ☐WordPerfect 5.1 for Windows . 279
1466 ☐WordPerfect 5.1 Additional User ..... 199.

XTREE ... NCP
6161 ▣XTree Gold 2.5 ..... 99.

Microsoft ... NCP

7388 ▣*Project 3.0 for Windows*—Take charge of your plans with the newest version of Microsoft's best-selling project management software. Includes a customizable toolbar and PlanningWizards..... **$445.**

RECREATIONAL/EDUCATIONAL

Abracadata ... NCP
3641 ▣Design Your Own Railroad ..... $39.
3629 ▣Design Your Own Home-Architecture 3.0 63.
3631 ▣Design Your Own Home-Interiors 1.0 .. 63.

Broderbund ... CP
8068 ▣Where in World is Carmen Deluxe..... 49.
1836 ▣Where in America's Past is Carmen ... 39.
5851 ▣SimCity from Maxis..... 29.
4388 ☐SimAnt from Maxis ..... 39.
4411 ▣SimEarth for Windows from Maxis .... 45.

Davidson & Assoc. ... NCP
3947 ▣Math Blaster Plus ..... 29.
4183 ▣KidWorks ..... 29.

Electronic Arts ... NCP
4534 ▣Mavis Beacon Teaches Typing 2.0 *(CP)* 35.
3031 ▣Mavis Beacon for Windows 45
3023 ▣ChessMaster 3000 ..... 35.

Harvard Associates ... NCP
2324 ▣PC Logo 3.0 ..... 59.

HyperGlot Software ... NCP
(French, German, Italian, Spanish available.)
☐Word Torture for Windows ..... ea. 34
☐Word Torture 3.0 ..... ea. 29.

Knowledge Adventure ... NCP
1483 ▣Sports Adventure 1.0 ..... 55.
3861 ▣Knowledge Adventure 1.0 ..... 55.

Cardinal ... 1 year

Cardinal 9600 Modem—Superior American built quality. Supports V.32 9600 bps operation with V.42bis data compression for speeds up to 38,400. As written about in *Business Week* (8/19/91).
2783 *External*.. $349. 1480 *Internal*.. $329.

Microsoft ... NCP
7881 ☐Entertainment Pack I for Windows..... 29.
2858 ☐Flight Simulator 4.0..... 39.

Penton Overseas ... NCP
▣VocabuLearn/ce Levels I & II *(French, Italian, German, Spanish, Russian, Hebrew and Japanese)*..... ea. 35.

Personal Training Systems ... NCP
Training tutorials - beg. to adv. for Windows, Excel, PageMaker, & Lotus 1-2-3 *(3½")* ea. 65.

Sierra ... CP
9466 ☐Space Quest IV *(VGA)*..... 45.
3193 ☐Police Quest III *VGA)*..... 45.

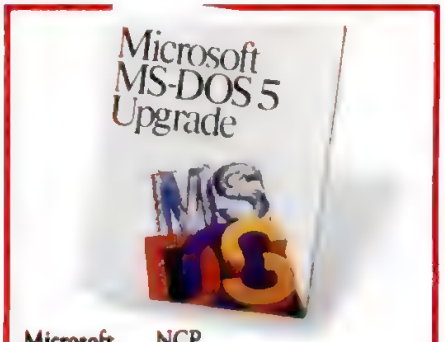
Software Toolworks ... NCP
3294 ▣Game Pak *(5 games in one)* ..... 32.
5032 Miracle *(piano teacher) (incl. kybd.)* .... 339.

Spectrum Holobyte ... NCP
4834 ▣Super Tetris..... 29.
4833 ▣Super Tetris for Windows..... 29

Toyogo ... NCP
2701 ▣Nemesis Go Master 5.0 for Windows .. 35.
7674 ▣Nemesis Go Master 5.0 ..... 35.

True BASIC, Inc. ... NCP
▣Kemeny/Kurtz Math Series ..... ea. 45.

Walt Disney Computer Software ... CP
2629 ▣Mickey's 123's ..... 29.
2624 ▣Mickey's ABC's ..... 29.
4398 ▣The Animation Studio ..... 79.
4416 Sound Source ..... 29.



Microsoft ... NCP

1620 ☐*MS-DOS 5 Upgrade*—Improved graphical shell, on-line help, task swapping, full screen editor, & more are all awaiting you w/MS-DOS 5 Upgrade. Upgrade your current DOS with ease to MS-DOS 5 Upgrade for only ... **$49.**

HARDWARE

Warranties listed next to manufacturer.

American Power ... 2 years
7108 Smart UPS 400 ..... 339.
7105 Smart UPS 600 ..... 425.
3858 Back-UPS 400 ..... 185.
3823 Back-UPS 600 ..... 299.

Appoint ... limited lifetime
2469 Thumbelina PC ..... 62.
2480 Mouse Pen Pro PC..... 62.

ATI Technologies ... 2 years
9821 VGA Basic-16 *(640 x 480, 16 colors)*..... 69.
9985 VGA Integra *(1024 x 768, 16 colors)* ..... 95.
2706 VGA Wonder XL *(with 1 MB)*..... 199.
2382 Graphics Vantage VGA *(with 1 MB)* ... 359.
9822 8514/Ultra *(with 1 MB) (requires VGA)*... 419.
2012 Graphics Ultra with VGA *(with 1 MB)* .. 479.
1825 2400etc/i Modem *(with 9600 SendFax)* . 139.
9620 9600etc/e Modem ..... 369.
3902 Stereo•F/X ..... 149.
3900 VGA Stereo•F/X *(w/512K, upgrd. to 1 MB)* 329.

Boca Research ... 5 years
7150 BOCARAM/AT PLUS *(2 MB)* ..... 209.
7139 *(4 MB)* .... 319. 7138 *(8 MB)* ... 529.
6998 I/O Board for AT ..... 49.
6999 I/O Board for Microchannel *(S/S/P)*..... 95.
8380 BasicVGA *(256K, 640 x 480)* ..... 49.
8381 SuperVGA *(1 MB, 1024 x 768)* ..... 119.
3859 2400 Internal Modem *(V.42, MNP Level 5)* 85.
2502 2400 Internal Modem..... 49.

Bravo Communications ... 2 years
7400 2 Position Laser Compatible Switch Box. 109.

Brown-Wagh ... 1 year
8578 Creative Labs Sound Blaster ..... 109.
2336 Creative Labs Sound Blaster Pro ..... 189.

Caere ... 1 year
8158 Typist Plus Graphics..... 389.

Canon ... 1 year
We are an authorized Canon Service Center.
7894 BJ-10ex Printer *(4.6 lb.)* ..... 329.
7897 BubbleJet Ink Cartridge *(BJ-10ex)* ..... 23.
7896 BJ-10ex Sheet Feeder ..... 75.

Cardinal ... 1 year
2719 MB2296SR Internal Send/Receive Fax.. 105.
1132 386-SX-16 Motherboard ØK ..... 279.
1197 386-SX-25 Motherboard ØK ..... 349.
2721 VGA732 True Color Ultra VGA Card .... 185.
1480 Cardinal 9600 Internal Modem..... 329.
2783 Cardinal 9600 External Modem ..... 349.

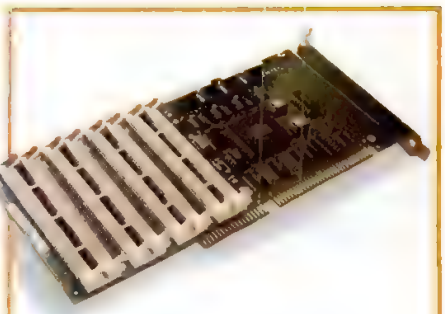
CH Products ... 1 year
7935 Game Card III Auto .. 33. 7341 MCA .. 49.
7801 FlightStick with Falcon ..... 49.

Colorado Memory Systems ... 1 year
4194 Jumbo 120 Tape Backup ..... 199.
4354 Jumbo 250 Tape Backup..... 269.

anniversary year.

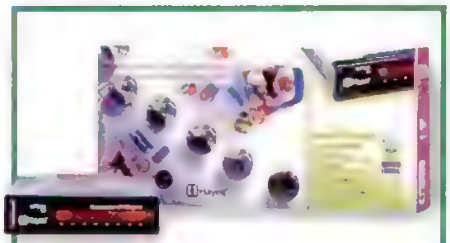
Zoom Telephonics/Delrina Technology
Zoom 2a/9e Fax Modem/Delrina WinFax Pro Bundle–Get this great 9600 bps send/receive fax with 2400 baud modem along with Delrina's WinFax Pro at a special price. Offer good thru 4/30/92. 4400 *Int. Bundle* $155. 4401 *Ext. Bundle* $159.

Kensington Microware ... 1 year
Full line available. Partial listing.
4973 PowerTree 20 *(6 outlets, EMI/RFI Filtering)* $27.
2582 Master Piece Plus ... 99.
7899 Expert Mouse *serial* .. 99. 7900 *bus* .. 115.
3311 MasterStand ... 59.
3312 LaserStand *(for HP LaserJet)* ... 125.
Keytronic ... 3 years
4518 101 Plus Keyboard ... 99.
Kraft ... 5 years
5801 Game Card *(2 ports)* ... 27.
5813 Game Card with Thunderstick ... 49.
5800 3 button Thunder Joystick ... 29.
Logitech ... limited lifetime
6029 Trackman *serial* ... 69.
2343 Trackman Portable ... 99.
7975 ScanMan 256 ... 289.
1322 FotoMan *(camera for your PC)* ... 549.
4727 Kids Mouse ... 45.
3295 MouseMan *(combo)* 69. 9766 *(cordless)* 89.
Megahertz ... 5 years
3020 T224FM 96/24 Pocket Fax Modem ... 249.
1187 T324FM 96/24 Fax Modem *(Toshiba Lptps.)* 269.
Micron Technology ... 2 years
7595 2 MB Expansion for HP LaserJet IIP or III 119.



Intel ... 5 years
1086 *Matched Memory Classic Memory Board 0K*–Great performance with a great price to match. EMS 4.0 compatibility built in to the hardware for up to 90% faster processing. Expandable to 8 MB using 1 MB SIMMs ... $139.

Curtis ... lifetime
1708 Ruby-Plus SPF-2+ ... 65.
7358 Command Center SPF-4 ... 89.
Cyrix Corporation ... 5 years
MATH COPROCESSORS
9875 FasMath 83D87-25 ... 165.
9876 FasMath 83D87-33 ... 175.
9877 FasMath 83S87-16 *(SX compatible)* ... 105.
Epson ... 2 years
We are an authorized Epson Service Center.
1906 FX-850 *(80 col., 264 cps, 9 pin)* ... 319.
1904 FX-1050 *(136 col., 264 cps, 9 pin)* ... 449.
2358 LQ-570 *(80 col., 252 cps)* ... 289.
2361 LQ-870 *(80 col., 330 cps)* ... 489.
2357 LQ-1170 *(136 col., 330 cps)* ... 669.
5184 LX-810 *(80 col., 180 cps, 9 pin)* ... 185.
Everex ... 1 year
1683 Tempo LX Notebook *(5 MB, 60 MB HD)* .. call
Hauppauge Computer ... 1 year
9870 25 MHz 386N Motherboard for AT *(1 MB)* 729.
9034 33 MHz 386N Motherboard for AT *(1 MB)* 789.
Hayes ... 2 years
7391 ULTRA 96 Modem ... 669.
5024 ULTRA 144 Modem ... 799.
1345 OPTIMA 24 Modem ... 155.
3522 OPTIMA 96 Modem ... 389.
9884 Pocket Edition 2400 ... 119.
Hewlett-Packard ... 1 year
3957 LaserJet IIP Plus *(with toner)* ... 879.
9993 LaserJet IIIP *(with toner)* ... 1099.
6754 LaserJet III *(with toner)* ... 1599.
Intel ... 5 years
3864 14.4EX Modem ... 549.
6421 2400B MNP Internal Modem ... 189.
6420 2400EX MNP Modem ... 225.
7880 9600EX Modem ... 469.
5336 Above Board Plus 8 2 MB ... 429.
5342 Above Board Plus 8 I/O 2 MB ... 459.
1086 Matched Memory Classic Memory Brd. 0K 139.
7782 SatisFAXtion *(fax board)* ... 389.
8903 Matched Memory 4 MB *(PS/2)* ... 239.
Matched Memory *(for LaserJet IIP, III, IIIP IIID)*
1810 1 MB ... 79. 1787 2 MB ... 149.
3076 Snap-In 386 *(for PS/2 50/60)* ... 389.
3358 Power Pak *(Snap-In 386 & Above Board Microchannel 4 MB)* ... 925.
MATH COPROCESSORS
7385 80287XL *(16 MHz 80286 CPU's)* ... 89.
4750 80387SX *(16 MHz 80386SX CPU's)* ... 129.
6830 80387SX-20 *(20 MHz 80386SX CPU's)* . 139.
5409 80387-33 *(80386DX CPU's)* ... 219.



Hayes ... 2 years
1345 *OPTIMA 24 Modem*–An affordable high-speed V.42bis modem with the reliability and quality that made Hayes famous. Supports throughput up to 9600 bps. Incl. Smartcom EZ communication software ... $155.

Microsoft ... lifetime
7597 Microsoft Mouse *(bus or serial)* ... 85.
2897 Mouse with Paintbrush *(bus or serial)* ... 99.
2898 Mouse with Windows 3.0 *(bus or serial)* . 149.
1896 Ballpoint Mouse *(serial only)* ... 119.
MicroSpeed ... 1 year
2763 MicroTRAC *(serial & PS/2 interface)* ... 57.
6330 PC-TRAC Trackball *(PS/2)* ... 79.
6007 *serial* ... 75. 6008 *bus* ... 89.
Microtek ... 1 year
2736 ScanMaker 600G *(gray-scale scanner)* .. 759.
2739 ScanMaker 600Z *(color scanner)* ... 1249.
2740 ScanMaker 1850 *(slide scanner)* ... 1649.
Mouse Systems ... lifetime
5997 Trackball *(1 yr. wrnty.) serial* .. 49. *bus* .. 59.
3213 PC Trackball II *(serial)* ... 69.
7878 PC Mouse III *(serial)* ... 89. *(bus)* ... 95.

NEC ... 2 years
9441 CDR-36 Portable CD-ROM Drive ... 399.
5161 CDR-73 CD-ROM Drive ... 589.
2478 CD Gallery with CDR36 for PC ... 579.
4252 Multisync 3FGX Monitor *(14")* ... 689
4249 Multisync 4FG Monitor *(15")* ... 799
Okidata ... 1 year
We are an authorized Okidata Service Center.
5093 *OL400 Page Printer (4 ppm)* ... 649.
5094 OL830 Page Printer *(8 ppm)* ... 1329.
3025 Toner Cartridge ... 25.
Orchid Technology ... 4 years
7863 ProDesigner VGA IIS *(with 1 MB, includes RAMDAC chip)* ... 249.
4071 Fahrenheit 1280i with 1 MB ... 365.
Pacific Data ... lifetime/60 day MBG
5072 25 Cartridges in One! *(for DeskJet 500)* . 109.
5071 25 Cartridges in One! *(for DeskJet Plus)* . 109.
6779 25 Cartridges in One! *(LJ II, IID, IIP, III, IIID)* 269.
8975 Complete Font Library *(LJ III, IIID, IIIP)* .. 265.
Memory upgrade for LJ IIP, III, IIID, IIIP:
7055 *2 MB* ... 139. 7759 *4 MB* ... 259.
Memory upgrade for LaserJet II/IID:
6838 *2 MB* ... 249. 6836 *4 MB* ... 369.
8090 Pacific Connect with 1.25 MB ... 349.

Pacific Data ... lifetime/60 day MBG
9833 *PacificPage XL for HP LaserJet IIP/III/IIID/IIIP*–High-speed PostScript emulation cartridge & accelerator board with 2 MB of memory. Output up to 8 times faster than stand-alone cartridges. 60 Day Money-Back Guarantee $699.

1-800/800-0004

MMC **PC Connection** 950M
6 Mill Street
Marlow, NH 03456
SALES 603/446-7721 **FAX** 603/446-7791

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We're 10 years old!

7158	Pacific Page PE *(LJ IID, IIP, III, IIID, IIIP)*	$369.
6834	Pacific Page *(for LJ II)* w/2 MB Mem. Brd.	369.
9833	Pacific Page XL *(w/accelerator board)*	699.
	PC Power & Cooling ... 2 years	
	REPLACEMENT POWER SUPPLIES	
3203	Turbo Cool 200	149.
7915	Turbo Cool 300	159.
	Practical Peripherals ... lifetime	
3103	2400 Baud Internal Modem	79.
3102	2400 Baud External Modem	169.
8993	2400 Baud Internal Modem *(V.42 bis)*	165.
8994	2400 Baud External Modem *(V.42 bis)*	199.
4542	2400 Baud Internal Modem for PS/2	229.
8132	PM2400 Pocket Modem	109.
2266	PM9600 Internal Modem	399.
7934	PM9600SA Modem	469.
2264	PM2400FX96 *(int. modem/fax board)*	95.
2425	PM14400FXSA Modem/Fax	399.
	Prometheus ... 2 years	
1222	ProModem Ultima Home Office	489.
	Targus ... lifetime	
1305	Universal Notebook *(computer case)*	69.
	TheComplete PC ... 2 years	
5828	TheComplete Communicator	299.
	Tripp Lite ... 2 years	
6199	Isobar 4-6 *(4 outlets, Gold Seal Warranty)*	49.
6200	Isobar 6-6 *(6 outlets, Gold Seal Warranty)*	59.
6201	Isobar 8-12 *(8 outlets, Gold Seal Warranty)*	69.
6018	LC1200 *(1200 Watt Line Conditioner)*	159.
	Video 7 ... 7 years	
9768	VRAM II VGA 1 MB	329.
	Zoom Telephonics ... 7 years	
1307	Int. 2400 Baud w/9600 Baud Fax Modem	105.
1178	Ext. 2400 Baud w/9600 Baud Fax Modem	115.
1181	2400 Baud V.42 bis Modem *(2 year)*	115.
3574	Ext. 2400 Baud V.42/9600 Baud Fax	145.
1167	2400 Baud Internal Modem	65.
1166	2400 Baud External Modem	69.
3075	9600 V.32 Turbo Internal Modem *(2 yr.)*	329.
1494	9600 V.32 Turbo External Modem *(2 yr.)*	329.
4400	24/96 Int. Fax Modem/WinFax Pro Bundle	155.
4401	24/96 Ext. Fax Modem/WinFax Pro Bundle	159.

Canon ... 1 year
7894 BJ-10ex Printer—New enhanced version of the popular 4.6 lb. printer provides laser-like print quality (up to 360 dpi) on plain bond paper, envelopes or transparencies. Available in white or gray ..... $329.

DRIVES

	Conner Peripherals ... 1 year	
2339	CP30104 120 MB IDE HD *(19 ms)*	399.
1337	CP3204 200 MB IDE HD *(16 ms)*	599.
	IOMEGA ... 1 year	
	We are an authorized Iomega Service Center.	
2224	Bernoulli II Transportable 90 MB	799.
2616	Internal 90 MB Bernoulli	799.
2500	PC2B Controller	199.
2530	90 MB Cartridge	149.
2467	90 MB Cartridge Tripak	439.
	Mountain Network Solutions ... 2 years	
2917	40-60 MB Internal Tape Drive	259.
6153	DC2120 Tape Cartridge *(5 pack)*	149.
	Pacific Rim ... 1 year	
1304	1.2 MB External *(for any parallel port)*	$239.
2761	1.44EX MB External *(for any parallel port)*	239.
	Quantum ... 2 years	
8304	Plus Hardcard II XL 50 MB *(9 ms)*	299.
8287	Plus Hardcard II XL 105 MB *(9 ms)*	449.
4060	105 MB Drive Kit for MC PS/2's *(13 ms)*	789.
	TEAC ... 1 year	
4670	1.44 MB Drive for PC/XT *(3½")*	59.
4326	1.44 MB Drive for AT *(3½", w/Bastech)*	79.
4951	720k Drive for PC/XT *(3½")*	55.
6951	1.2 MB Drive for AT *(5¼")*	65.

MEMORY

6556	256k DRAM *(100 ns, set of 9)*	19.
5510	1 MB x 9 SIMMs *(80 nanosecond)*	49.
2497	4 MB x 9 SIMMs *(80 nanosecond)*	179.
5746	1 MB Chips *(80 ns, set of 9)*	49.
7813	256K x 4 Chips	ea. 7.

AddStor ... NCP
4090 ▣ *SuperStor 2.0*—Doubles your disk capacity with an advanced, feature rich software only data compression product. Easy to install and use. Compatible with Windows and all applications ..... $83.

Practical Peripherals ... lifetime
2425 PM14400FXSA Modem/Fax—Get ultra high speed 14,400 bps data transmission as well as Group III S/R fax capabilities in one integrated and affordable package. Includes QuickLink II for modem and fax communications .. $399.

DISKS/MEDIA

	Fuji ... lifetime	
2215	3½" HD Disks *(10)* ... 15. 2241 *(50)*	... 69.
2239	3½" HD Disks Color *(Qty. 10)*	18.
2214	3½" DS Disks *(10)* ... 9. 2242 *(50)*	... 39.
2243	3½" DS Disks Color *(Qty. 10)*	10.
	Fuji ¼" Data Cartridges	call
	Sony ... lifetime	
3291	5¼" DS/DD 360k Disks *(Qty. 10)*	7.
3292	5¼" HD Disks *(Qty. 10)*	12.
3297	3½" DS Disks *(10)* .. $9. 6148 *(30)*	.. $25.
3298	3½" HD Disks *(10)* ... 15. 6375 *(30)*	... 42.
1603	DG60M 4mm Data Cartridge *(1.3 GB)*	... 16.
2520	DG90M 4mm Data Cartridge *(2 GB)*	.... 22.
1609	QG112M 8mm Data Cartridge *(5 GB)*	.... 15.
8185	QD2040 Tape Cartridge	14.
3988	QD2080 .... 19. 1895 QD2120	.... 21.
6715	QD6150 .... 23. 1602 QD6250	.... 29.
	3M ... lifetime	
3943	DC2000 .... 17. 1581 DC2120	.... 24.

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- We accept VISA and MASTERCARD.
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- To order, call us Monday through Friday 8:00 a.m. to 1:00 a.m., or Saturday 9:00 a.m. to 5:30 p.m. Eastern Time. You can call our business offices at 603/446-3383 Monday through Friday 9:00 a.m. to 5:30 p.m.

IOMEGA ... 1 year
2224 Bernoulli II Transportable 90 MB—Rugged and built to last, this drive will absorb 1000 g's of shock and provide 90 MB of portable storage. Awards from *Byte* and *InfoWorld*. Requires adapter card ..... $799.

SHIPPING

Note: Accounts on net terms pay actual shipping.

Continental US:

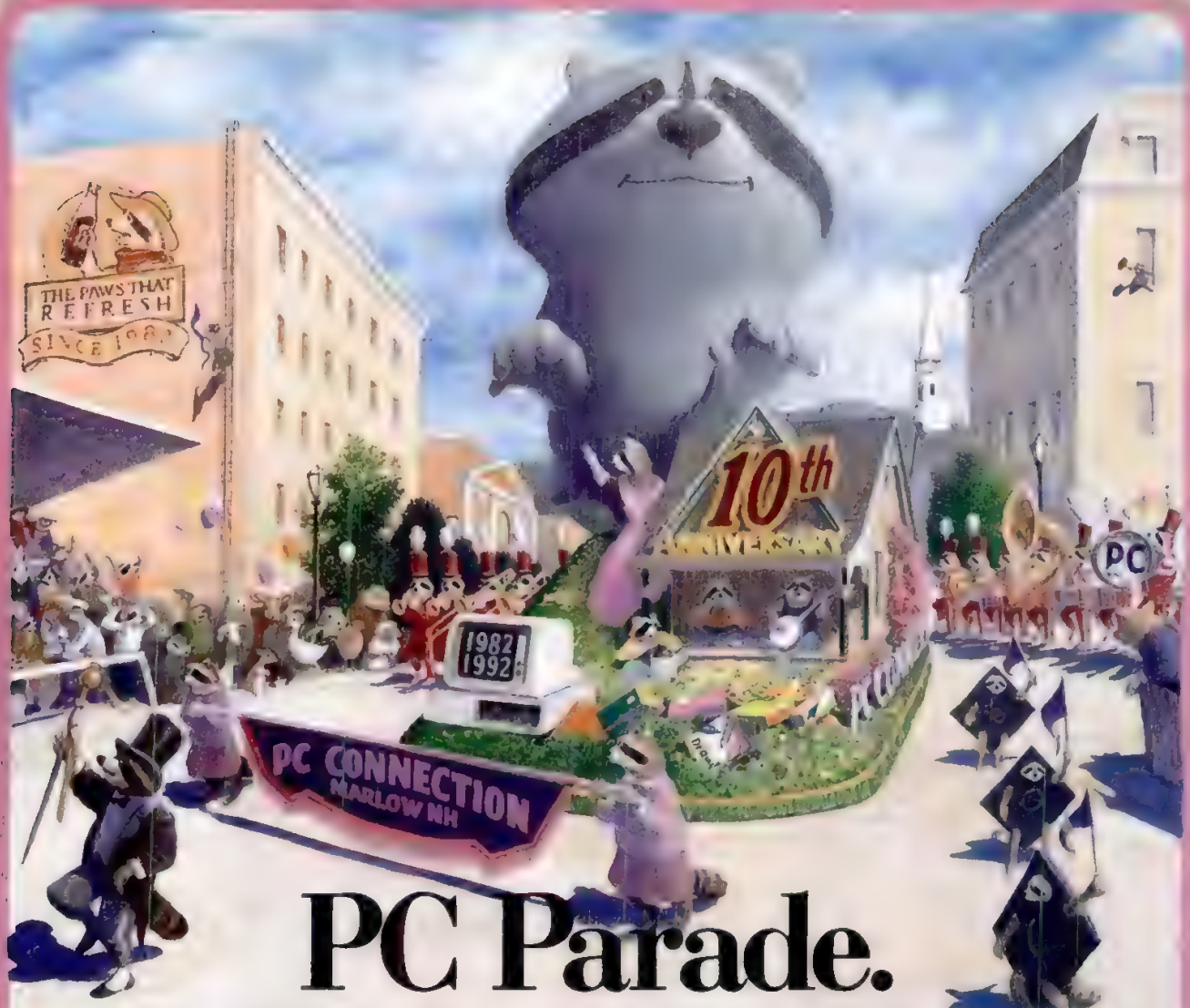
- For heavy hardware items such as printers, monitors, Bernoulli Boxes, etc. pay actual charges. Call for UPS 2nd-Day & Next-Day-Air.
- For all other items, add $3 per order to cover UPS Shipping. For such items, we automatically use Airborne Express at no extra charge if you are more than 2 days from us by UPS ground.

Hawaii:

- For monitors, printers, Bernoullis, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add $3 per order.

Alaska and outside Continental US:

- Call 603/446-7721 for information.



PC Parade.

From Marlow to Main Street.
(Or, a decade of service to beat the band.)

Back in July of '82, shortly after the introduction of the IBM-PC, we marched (to the beat of a different drummer, of course) smack dab into the middle of the PC marketplace. Our idea was simple—to sell add-ons and software exclusively for IBM personal computers. Our first warehouse was even simpler—a closet in a converted sawmill in the one-horse (or was that a moose?) town of Marlow, NH (pop. 542 at the time). Our goals were rather modest, too—we just wanted to be the fastest, most convenient, and most reliable source for PC products anywhere on Planet Earth.

Over the last ten years, we've learned that our small-town values play pretty well across America. And that anything humans can do, our high-stepping raccoon mascots can do better. So as our first decade draws to a close, we'd like to thank all our customers for making it so successful. May it never rain on your PC parade!

We'll give you the shirt off our backs!

The Official PC Connection 10th Anniversary Shirt, that is. A collector's item that can be worn with pride and panache at road races, corporate volleyball games, and even user-group meetings. It's free to anyone who places an order of $750 or more between now and June 30. Specify S, M, L, XL or children's.

Display your micro muscles with the all-cotton PC Connection 10th Anniverary Shirt. One per customer. Not available to net accounts.

PC CONNECTION®

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Once gray-scale scanners began to sell, it was only a matter of time before prices began to fall—and before color scanners, benefiting from the cost savings of the same CCD technology, began to approach mainstream price levels. Of course, the same forces have brought the cost of color page printers down to more reasonable levels, and this, too, has made color scanners a more attractive option.

CHOOSING A SCANNER

The nine scanners reviewed here cover a range of features, with no two products offering precisely the same mix. Your choice should depend on a variety of considerations, but the quality of scans should figure prominently in your decision: All scanners certainly are not alike, nor do all deliver the same image quality.

We rated image quality by examining professionally produced output of numerous scans, all generated by scanning at default settings (for details, see the sidebar "How We Tested"). An experienced operator could have improved many of our images by tweaking the scan settings, but common sense dictates that you should begin with the best images possible, particularly if you can claim little experience with image editing. Preparing even an excellent image for publication requires time, patience, and skill.

Resolution, of course, ranks high on the list of factors that determine image quality, and here you'll find notable differences among the nine offerings, both in their true optical resolution (the fixed number of dots per inch that the CCD is capable of recording horizontally across the page) and in the varied resolutions they can deliver via sampling or interpolation.

To process images at resolutions lower than the optical resolution, a scanner must either sample pixels—dropping out every other pixel, for example, to achieve half the optical resolution—or calculate the average of the appropriate number of pixels. To achieve higher-than-optical resolutions, a scanner must interpolate, but different algorithms will produce different results. Some interpolation algorithms are based on pixel averaging, which theoretically should give optimal results; others depend on simple pixel replication. The HP ScanJet IIc combines both approaches, using pixel averaging to double its base resolution to 800 dpi, then pixel replication to boost the resolution as high as 1,600 dpi.

A different set of factors determines resolution in the vertical dimension. Flatbed scanners typically use a "stepper" motor to move the scan mechanism down the length of the scan bed in precise increments. Thus, up to a given limit, the scanner can alter the vertical resolution simply by changing the increment at which it moves the mechanism. The ScanJet, for instance, uses this method to achieve 400 dpi, resorting to pixel replication for higher resolutions. The Microtek ScanMaker 600Z scans with incremental positioning at up to 600 dpi vertically.

Scan speed is another important selection criterion, especially for those who plan to undertake substantial amounts of OCR work. PC Magazine Labs' testing showed considerable differences between the fastest and slowest machines on every test. In line-art mode at 300 dpi, for instance, the HP ScanJet IIc scanned our text page in 22 seconds, while five of its competitors required 115 seconds or more to complete the same task.

In general, you can expect to wait roughly twice as long for a color graphics scan as for gray-scale. With a fast scanner, this difference might translate into a half a minute or so. With a slow scanner, the step up to color may cost you 2 minutes or more.

Oddly enough, on our tests, the time required to complete a scan generally failed to correlate with the quality of the scan produced. Similarly, while it stands to reason that a single-pass scanner would be faster than a three-pass model, our testing proved this utterly false: The single-pass HP ScanJet IIc landed at the fast end of the range on every test, while the other single-pass model, the Epson ES-300C, landed at the slow end. The AVR 8000/CLX Color Image Scanner, a three-pass

EDITORS' CHOICE

■ **HP ScanJet IIc**

There are no losers in our field of nine products—which is good news for prospective buyers. While several of the scanners demonstrated notable image quality or speed (the two principal criteria of scanner excellence), only one—Hewlett-Packard's HP ScanJet IIc—excelled in both categories. To the competition's credit, the ScanJet was not the absolute winner in either area. But in both cases it was in the top group—at a level that makes drawing significant distinctions difficult. Couple its outstanding overall performance with a true optical resolution of 400 dots per inch, an excellent scanning software package (*DeskScan II*), and HP's well-earned reputation for solid, reliable products, and you have a winning combination.

The Microtek ScanMaker 600Z earns a very honorable mention. It is certainly the ScanJet's peer in terms of image quality, but its lackluster performance on our speed tests makes it a less-than-ideal choice for applications where speed really counts, such as OCR. Those for whom speed is not an important consideration may well want to consider the Microtek: Its optical performance is beyond reproach, it offers extended resolution (optically, 300 dpi horizontal by 600 dpi vertical), and at $1,995, it is certainly priced right. Furthermore, Microtek Lab has been in the scanner business a long time, during which its products have earned a reputation as reliable workhorses.

Somewhat lesser places of honor go to the Epson ES-300C and the XRS 6C OmniMedia. The Epson has impressive features, which produce perhaps the best scans of the whole group. Unfortunately, it is slow and does not offer an automatic document feeder, which takes it out of the running for meaningful volumes of OCR work.

The XRS is an enhanced version of the Microtek, and it produces similar performance across the board. Its built-in transparency-scanning capability, however, makes it stand out. The downside is a price nearly twice that of the Microtek unit.

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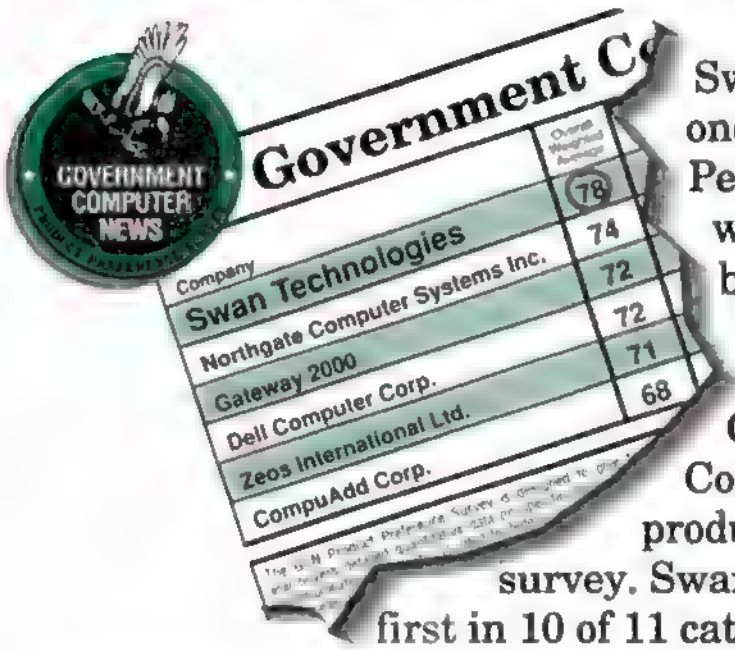

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model, proved faster than the ScanJet on several tests.

Keep in mind that the scanner driver used often plays a large role in determining scan speed and quality. For example, the Howtek Personal Color Scanner, one of the fastest units when tested with Micrografx's *Picture Publisher LE*, turned sluggish with *ColorLab* from Computer Presentations Inc. The *ColorLab* driver, on the other hand, delivered better image quality. The versions of *Picture Publisher* provided with most of the evaluation units were newly minted when we tested. While we had no problems with *Picture Publisher LE*, the drivers obviously needed work. Vendors can often improve various aspects of performance over a period of time simply by improving their drivers, and buyers should expect this to happen for a number of these scanners.

Other hardware features to consider include the range of brightness and contrast levels, support for image scaling in hardware, and gamma correction—the algorithmic adjustment of individual red, green, and blue values to compensate for differences among output devices and eccentricities of input devices. All of these are factors in determining basic image quality.

If you need the ability to scan transparencies, you'll want to choose one of the two scanners that offer this capability as a standard feature—the Abaton Scan/300 Color and the XRS 6C OmniMedia—or the one that provides it as an $895 option, the UMAX UC630.

BUNDLED SOFTWARE

Unless you have already invested in a sophisticated image-editing package—software that can set you back $500 or more—you should also be interested in the capabilities of the bundled software each scanner vendor provides. *Picture Publisher LE*—the OEM version of Micrografx's *Picture Publisher*, Version 3.0—arrived with three of the scanners we reviewed. *PhotoStyler*, *Picture Publisher*, and the DOS-based *Tempra Pro* offer highly sophisticated features such as masking—for those brave enough to try their hands at it. Look for a review of these image-editing packages and their competitors in an upcoming issue of *PC Magazine*.

One software issue to keep in mind while perusing the reviews is whether the image-editing package incorporates scan functions. Most do. AVR and Hewlett-Packard, for example, provide the scanning capabilities in a separate program. Although in the HP ScanJet IIc this arrangement seems to bring a speed advantage, some users will undoubtedly view the need to switch between programs as an annoyance.

Scan speed is an important criterion, especially if you depend on OCR work.

Those intending to put their scanners to work with OCR software should note the quality of the line-art scan results. They should also consider whether the manufacturer includes an OCR software package free with the scanner or offers one as an extra-cost option. If you are seriously interested in OCR, you might want Caere Corp.'s *OmniPage* or Calera Recognition Systems' *WordScan*. Ocron's *Perceive*, offered with the Marstek unit, is fine for occasional use.

Before you buy an OCR package from a scanner vendor, find out whether the version the company offers includes driver support you would not get with the retail version; you may be able to pick up the same package at a lower price elsewhere. For OCR on documents with 8-point type or smaller, you will also want to consider a scanner that has 400-dpi resolution or better.

Whether or not a particular OCR package supports a particular scanner may also be an issue. Given that the HP ScanJet IIc and the AVR 8000/CLX Color Image Scanner emulate the ScanJet Plus, which is supported by virtually every PC-based OCR package, you should have no problem finding software that will drive them. For the remaining scanners, be sure to check with the scanner vendor or the vendor of the OCR package you plan to use to make sure the scanner is supported. If you plan to make extensive use of OCR, you'll also want to be sure your scanner accepts an optional automatic document feeder. All but the Epson, Howtek, and Marstek units do (or will by the time this issue is in print).

A cautionary note regarding system resources is in order. Working with large files, like those generated by 24-bit scans, requires a great deal of memory and a large hard disk. We recommend 4MB RAM as a minimum, but you won't regret having 8MB. Likewise, we highly recommend a fast graphics adapter, preferably one that supports 32K colors. (For reviews of the new accelerated graphics adapters for Windows, see "Super VGA Boards: Fast Enough for Windows, Cheap Enough for You," *PC Magazine*, September 24, 1991.)

Of course, you can keep file size down through judicious scanning. For instance, you may seldom need to scan at a resolution of 300 dpi; as a rule of thumb, you only need an image resolution equal to the output device's resolution divided by 2 or 2.5. A scan meant for output on a 300-dpi laser printer, for example, requires a scan of only 120 to 150 dpi.

DIFFICULT BUT WORTH THE TROUBLE

Working with color is deceptively difficult and can make for a frustrating experience. Yet the best of these nine scanners, with their attendant software packages, should reward a little effort with satisfactory color results. And they will do so at a truly reasonable price.

Those whose scanning needs are limited to an occasional signature, company logo, or cartoon may want to save themselves some money by picking up a color hand scanner (see "Quick Graphics on a Budget: 12 Hand Scanners," November 12, 1991). Sheet-fed scanners, such as the Microtek MS-II ($995), The Complete Page Scanner (from The Complete PC, $899), and the ProScan PS-3000/OCR ($995), constitute another lower-cost alternative—although their inability to scan pages from bound material tends to limit their usefulness.

The flatbed scanners reviewed here offer the flexibility to scan images from a variety of sources. They also offer precision that neither hand scanners nor sheet-fed models can match. Whether you need a scanner primarily for OCR work, desktop publishing, image database applications, or multimedia presentations, one of these color desktop offerings should prove a smart long-range buy, even if a gray-scale model would probably suffice for your current needs. You may well find that one of these offerings will be all the scanner you'll need for some years to come.

ABATON

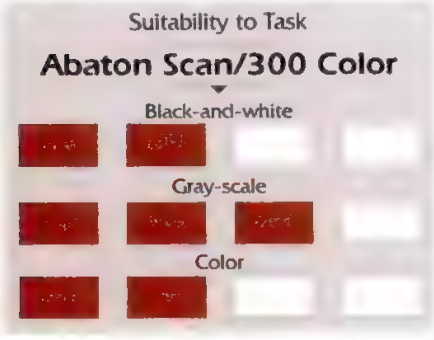
Abaton Scan/300 Color

BY GREG PASTRICK With color scanners, the distinguishing factors are usually output quality and speed. The Abaton Scan 300/Color excels at neither. What distinguishes this plainly packaged and plain-performing legal-size flatbed scanner is its software. Unlike most of the scanners in this review, Abaton's 24-bit color scanner is bundled with CPI's *ColorLab* 4.0, rather than the popular choice, Micrografx's *Picture Publisher LE.* While this doesn't seem particularly significant, *ColorLab* may be this scanner's most unique feature.

Like some of the other scanners in this review, the $1,995 Abaton is simply a color extension of its gray-scale doppelganger, the $1,595 Abaton Scan 300/GS. These products from the Everex Systems subsidiary look the same, have the same minimal hardware controls, and rely primarily on software to deliver enhanced scanning capabilities such as brightness, contrast, and scaling controls.

In this case, the software is CPI's *ColorLab*—a significant update to Version 3.1. The full-featured *ColorLab* software is specifically tailored for operation with the Abaton color scanner, which helps make it a good choice for image processing.

On the hardware side, the Abaton comes with an 8-bit Everex SCSI interface card, a cable, and a terminator. The only hardware controls on the unit are a power switch and a SCSI ID selector on the back of the scanner. It takes but a matter of minutes to set up and install the color scanner. An automatic setup utility configures the I/O port address and installs the device driver.



NO SPEED DEMON

In terms of raw speed, the Abaton performs admirably on 150-dot-per-inch color and gray-scale scans but shows a significant speed drop at its maximum 300-dpi resolution. On average, this scanner is one of the slower of the test group, regardless of the scanning mode or target size. The one exception is its text scanning speed, which is second only to the HP ScanJet IIc.

The quality of its output places the Abaton only slightly ahead of the AVR 8000/CLX Color Image Scanner. With its default settings, the unit's line-art scan output is satisfactory. While scans of information-rich targets, such as our Gammatrol test image, show a loss of detail, the image sampling of targets containing text, lines, and curves shows good resolvability. Generally, the gray-scale output shows a consistent loss of detail in the highlights. This tendency, however, is balanced by better sampling of lowlights. Its color output shows similar traits, but the overall effect is a washout of color rather than a loss of detail. This scanner samples CMYK values lightly and produces less of a dynamic range in hue and saturation than you want for 24-bit image sampling. The Abaton's tendency to produce light hues from dark ones does work well when producing dark images, but it unfortunately turns red into orange.

LIMITED SOFTWARE

The *ColorLab* 4.0 software bundled with the Abaton provides a good range of features and functions for sampling black-and-white, gray-scale, and color images. But it does have some limits. For the purposes of testing, we chose the default software settings to get a close measure of the scanner's native hardware capabilities. You should, however, beware of this approach. Since the Abaton cannot scale through hardware, *ColorLab* scales images by decreasing their resolution. By default, *ColorLab* compensates for the fact that it throws out pixels by antialiasing between the surviving pixels. This produces a pixellated effect when you print or view the image at higher resolutions (particularly when you zoom in while displaying the image). You get much better results using the pixel-averaging option.

ColorLab is particularly adept at post-scanning image enhancement. Though the software has no color or gray-scale calibration facilities, it lets you apply adjustments to scanned images, including brightness, contrast, color balance, global gamma correction, highlights, and shadows. These are essential, since the scanner cannot make these corrections in hardware. In addition, the software has a selection of standard color-reduction palettes and ordered or distributed dither patterns for image processing.

Abaton offers a 50-page automatic document feeder, which was not shipped for review. This $595 add-on is best paired with the company's $1,095 TranScribe 300 OCR scanner, though the Abaton supports *OmniPage* for capturing text scans. In the end, though, there is nothing that really distinguishes this color scanner from the other reviewed units. Look for better technology and speed elsewhere.

FACT FILE

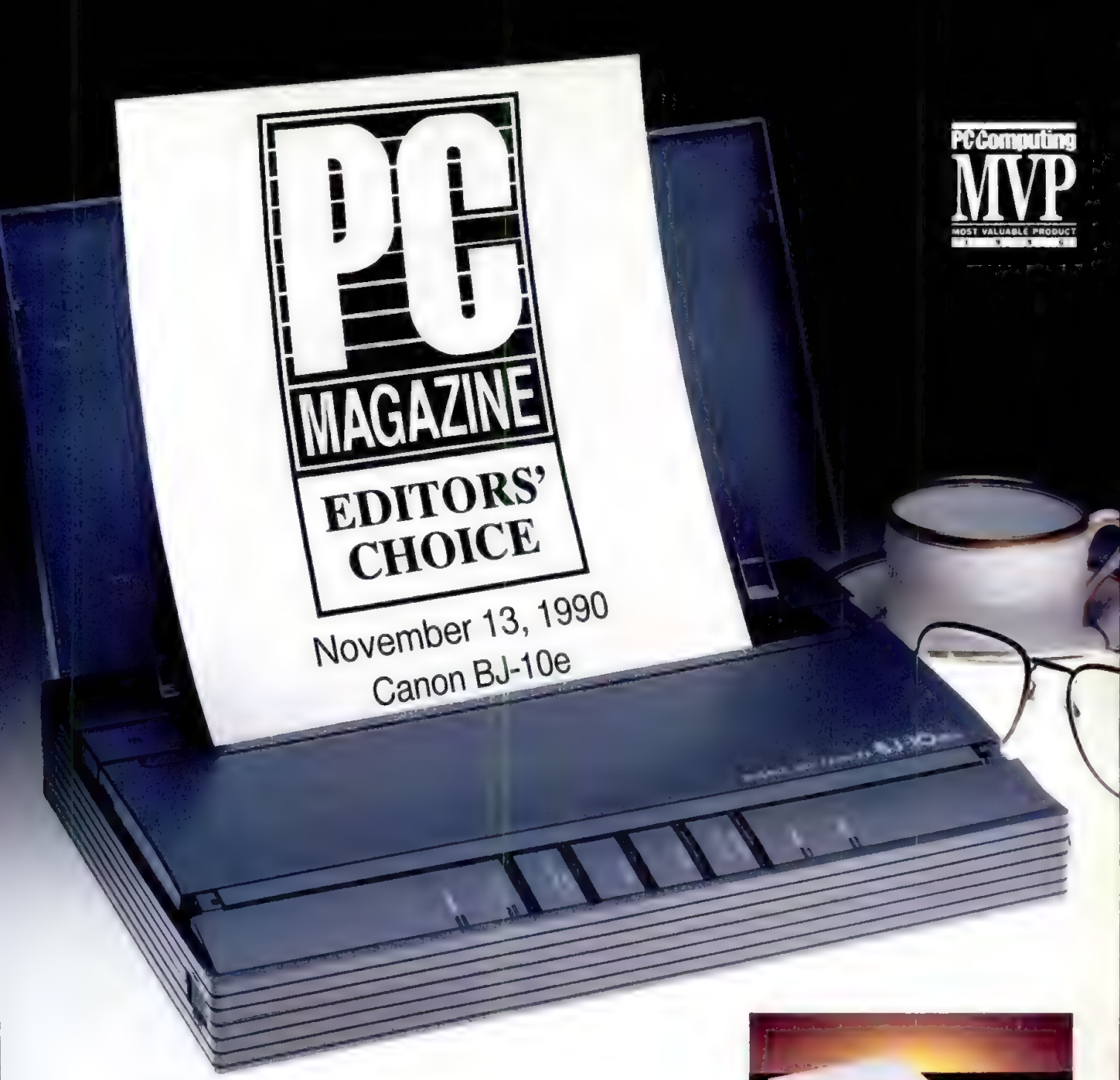
Abaton Scan/300 Color
Abaton, a division of Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; 800-628-3837, 510-498-1111.
List Price: With *ColorLab*, $1,995.
Requires: 1MB RAM, VGA display, Microsoft Windows 3.0.
In Short: There are too many other scanners that can produce better gray-scale and color output at faster speeds for us to make the Abaton Scan/300 Color a recommended scanning solution. Even so, its gray-scale output is acceptable, if only for its good capture of detail on dark images.

CIRCLE 459 ON READER SERVICE CARD

ADVANCED VISION RESEARCH INC.

AVR 8000/CLX Color Image Scanner

BY GREG PASTRICK This is a story about poor execution of a good idea. In August 1991, Advanced Vision Research rounded



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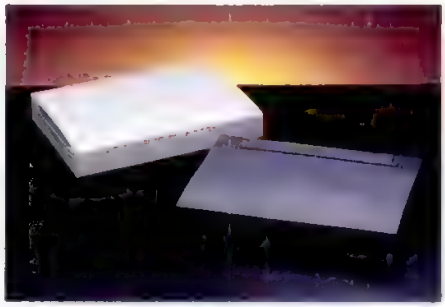

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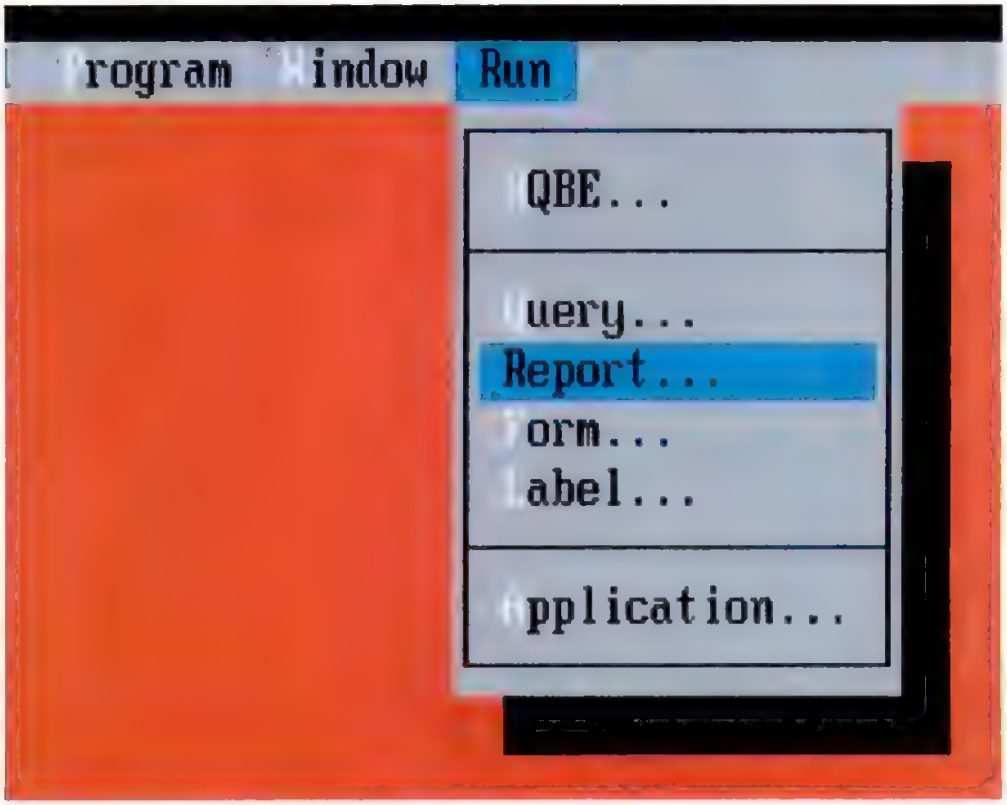

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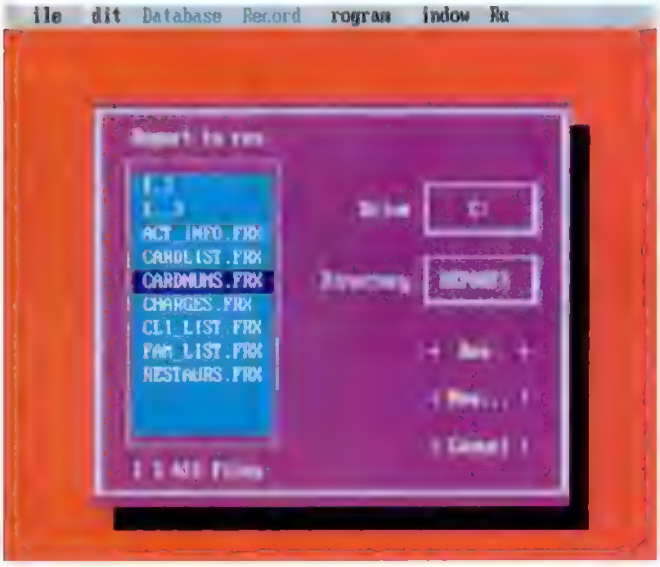

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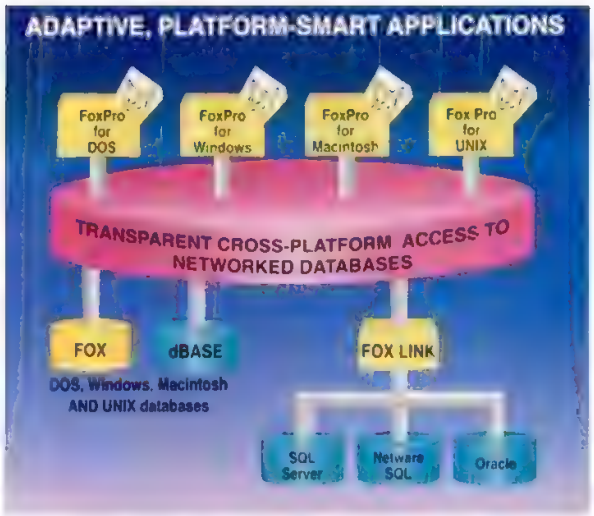

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FOX SOFTWARE

†Query benchmark tests performed by Micro Endeavors, Inc. (215) 449-4680, from Data Based Advisor 8/91

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CIRCLE 112 ON READER SERVICE CARD

SUMMARY OF FEATURES

Products listed in alphabetical order by company name

Editors' Choice
■—Yes ❑—No

	Abaton Scan/300 Color	AVR 8000/CLX Color Image Scanner	Epson ES-300C	Hewlett-Packard HP ScanJet IIc	Howtek Personal Color Scanner	Marstek MSF-3000C	Microtek ScanMaker 600Z
List price (with PC interface and software)	$1,995	$2,190	$2,194	$2,195	$1,295	$1,295	$1,995
PHYSICAL CHARACTERISTICS							
Footprint (in inches, LxW)	20.5 x 13.5	21.5 x 11.75	18.5 x 12.5	20.75 x 12.5	16 x 14	23 x 15	20.25 x 13.5
Weight (pounds)	22	15	20	29.5	19	24	19.6
Power-on/error-code indicators	■/❑	■/❑	■/■	■/❑	■/❑	■/❑	■/❑
Bed size	Legal	Legal	Letter	Legal	Legal	Legal	Legal
Maximum sheet size	8.5 x 14	8.5 x 14	8.5 x 11.7	8.5 x 14	8.5 x 14	8.5 x 14	8.5 x 13.5
Media:							
Scans photographs	■	■	■	■	■	■	■
Scans transparencies	■	❑	❑	❑	❑	❑	❑
Automatic document feeder	$595	$795	None	$695	None	None	$699
Bin capacity (sheets)	50	100	N/A	50	N/A	N/A	100
Paper sizes:							
Letter, legal, and European (A4)	■	■	N/A	■	N/A	N/A	■
Adjustable to any size	■	❑	N/A	■	N/A	N/A	■
Scan buffer size	32K	8K	N/A	64K	4K	N/A	16K
Interfaces offered:							
ISA/MCA	■/❑	■/■	■/■	■/■	■/■	■/■	■/■
Interface type	SCSI	SCSI-2	Bidirectional parallel	Proprietary	Bidirectional parallel	Proprietary	Proprietary
Board size	Half-size	Half-size	Half-size	Half-size	Half-size	Half-size	Half-size
Board type	8-bit	16-bit	8-bit	8-bit	8-bit	8-bit	8-bit
IRQs supported	2–5	9–12	5, 7	None	None	None	None
Optional Macintosh interface	■	■	■	■	■	■	■
SCANNING MODES							
Black-and-white scanning:							
Hardware resolutions (dpi)	72–300	100–400	50–300	12–400	1–600*	3–300	3–600*
Line-art mode	■	■	■	■	■	■	■
Dither (halftone) mode	■	■	■	■	❑	■	■
Number of dither patterns	4	5	3	6	N/A	12	12
Number of simulated gray shades	256	254	Info not available	256	N/A	256	64
Gray-scale scanning:	■	■	■	■	■	■	■
Hardware resolutions (dpi)	72–300	100–400	1–300	12–400	1–600*	3–300	3–600*
256 shades	■	■	■	■	■	■	■
64 shades	❑	❑	■	❑	❑	❑	❑
16 shades	■	■	■	■	❑	❑	❑
Color scanning:	■	■	■	■	■	■	■
Hardware resolutions (dpi)	72–300	100–400	1–300	12–400	1–600*	3–300	3–600*
Method	Three-pass	Three-pass	One-pass	One-pass	Three-pass	Three-pass	Three-pass
16.8 million colors	■	■	■	■	■	■	■
4,096 colors	■	❑	❑	❑	❑	❑	❑
256 colors	■	❑	❑	■	❑	❑	❑
HARDWARE-BASED SCANNING CAPABILITIES							
Brightness, contrast control levels	256, 256	None	7, 0	255, 255	None	14, 14	14, 14
Scaling levels (percent)	25–400	None	50–200	3–200	1–300	25–400	1–200
Gamma correction	■	❑	■	■	■	■	■
Number of curves	4	N/A	5	Unlimited	100	Unlimited	8
HP emulations (ScanJet/ScanJet Plus)	❑/❑	■/■	❑/❑	❑/■	❑/❑	❑/❑	❑/❑

N/A—Not applicable: The product does not have this feature.
* This product scans at 300 dpi horizontally and 600 dpi vertically.

	UMAX UC630	XRS 6C OmniMedia
	$1,995	$3,500
	20.25 x 12	20.25 x 13.5
	18	20
	■ / ■	■ / ■
	Legal	Legal
	8.5 x 14	8.5 x 13.6
	■	■
	$895	■
	$495	$699
	25	50
	■	■
	■	■
	128K	64K
	■ / ■	■ / ■
	SCSI	Proprietary
	Half-size	Full-size
	8-bit	8-bit
	3–5, 9	5
	■	■
	1–600*	100–300
	■	■
	■	■
	15	12
	145	256
	■	■
	1–600*	100–300
	■	■
	┘	┘
	■	■
	■	■
	1–600*	100–300
	Three-pass	Three-pass
	■	■
	■	┘
	┘	■
	50, 50	14, 14
	1–100	25–400
	┘	■
	N/A	6
	┘ / ┘	┘ / ┘

CONTINUES

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August 1991

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Windows Magazine, March 1992

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CIRCLE 399 ON READER SERVICE CARD

MOVING?

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out its three-product line of smartly designed color, gray-scale, and OCR scanners with the addition of the 400-dot-per-inch 24-bit color AVR 8000/CLX Image Scanner. Just in time for Fall Comdex, the company then released a set of scanning utilities called *ScanPack* 3.1, a collection of software tools for setting up and using the legal-size flatbed AVR 8000/CLX. Then as now, the $2,190 package includes an Adaptec SCSI-2 interface, a cable, the *ScanPack* utilities, and Micrografx's *Picture Publisher LE.*

On first look, the AVR 8000/CLX seems like a good true-color scanning solution. Unfortunately, this first iteration of the company's software proved to be problematic. Where the scanner itself appears to be well planned and well executed, the bundled utilities are not. *ScanPack* includes manual and quick-start installation programs, AVR's *EasyScan for Windows* scanning software, a driver and map files for using *Picture Publisher,* and SCSI device drivers. The utilities also contain features for image sharpening and resolution enhancement (up to 1,600 dpi in output). In stark contrast to the hardware's swift and silent performance, *ScanPack* 3.1 is really unacceptable for scanning. In all fairness to AVR, *EasyScan for Windows* is meant to be little more than what its name implies—an accessible utility that lets you perform quick black-and-white, color, and gray-scale scans, then save them to standard formats for image processing. Its poor execution does not inspire confidence, however.

The program contains a number of defects. Line-art scans invert the target image; to fool the software into capturing a 1-bit image right side up, you must check the invert-image option from the main scanning controls. In addition, the software has significant problems with gray-scale scanning functions: If you select "4-bit image" from the scan menu, the software crashes.

AN ALTERNATIVE SELECTION

Fortunately, the AVR 8000/CLX is bundled with alternative scanning software. This scanner also supports HP ScanJet Plus and basic HP ScanJet emulations for gray-scale scans, so you can choose from a variety of scanning software for this purpose. Our review unit was shipped with *Picture Publisher* 2.0, but since *Picture Publisher LE* is now bundled with all PC-compatible AVR color scanners, we used it in evaluating this scanner. Like the *EasyScan for Windows* software, however, the driver for *Picture Publisher* proved to be a problem during testing.

One of the nice features of this latest version of *Picture Publisher* is that the software lets you save color and gray-scale calibration settings to a single file. The trouble is that the AVR driver we used for *Picture Publisher* crashes the program when we selected the Create Calibration Map File as an option and applied it for a scan. According to AVR, this is a problem only with this model and not with the company's other color scanner, the $1,890 AVR 3000/CL Plus Image Scanner.

You may be lucky enough not ever to encounter these problems. This past January, AVR released Version 3.3 of *ScanPack,* which should fix many of these problems. Though it was not available by our testing deadline, *ScanPack* 3.3 includes the new *EasyScan for Windows,* an updated driver for *Picture Publisher* (which also works with Version 2.0), SCSI device drivers, and calibration files for the AVR 3000/CL and AVR 8000/CLX. If you acquired *ScanPack* before the 1992 update, you can receive the improved software tools free of charge from AVR or download the tools from AVR's BBS.

DARK BY DEFAULT

While the *ScanPack* defects were disturbing, they did not prevent us from testing the AVR 8000/CLX with *Picture Publisher* or produce unusable color or gray-

SUMMARY OF FEATURES

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★—Editors' Choice ■—Yes ❑—No

	Abaton Scan/300 Color	AVR 8000/CLX Color Image Scanner	Epson ES-300C	Hewlett-Packard HP ScanJet IIc	Howtek Personal Color Scanner	Marstek MSF-3000C	Microtek ScanMaker 600Z
SOFTWARE							
Scanning and editing software supplied	*ColorLab*	*Picture Publisher LE, ScanPack*	*ColorLab, Image-In-Color, Picture Publisher LE*	*DeskScan II, Publisher's Paintbrush*	*ColorLab, Picture Publisher LE, or Tempra Pro*	*Picture Publisher LE*	*PhotoStyler*
Global image correction	■	■	■	■	■	■	■
Masking	❑	■	■	■	■	■	■
Pixel editing	❑	■	■	■	■	■	■
OCR software	*OmniPage* ($695)	None	None	None	*WordScan*	*Perceive*	None
CUSTOMER SUPPORT							
Separate installation guide	■	■	❑	❑	❑	❑	■
Hardware warranty	1 year	2 years	1 year	1 year	1 year	1 year	1 year
Toll-free number	❑	■	■	■	■	❑	■

AVR 8000/CLX Color Image Scanner
Advanced Vision Research Inc., 2201 Qume Dr., San Jose, CA 95131; 800-544-6243, 408-434-1151.
List Price: With *Picture Publisher LE, ScanPack* 3.3, $2,190.
Requires: 386-based PC, 2MB RAM, VGA display, Microsoft Windows 3.0.
In Short: Just because a piece of hardware is fast does not mean it's the best. The AVR 8000/CLX Color Image Scanner can match the HP ScanJet IIc in raw scanning speed, but it cannot come close in output quality. Its dark image capture produces muddy color output that obscures detail.

CIRCLE 460 ON READER SERVICE CARD

scale scan output. We had to rely on the default AVR map file for *Picture Publisher* and the unit's internally housed rollout strip for calibration. The rollout strip is a gray-scale strip used by the scanner for its power-up calibration. It literally rolls out along the side of the scan bed as the scan head makes its start-up

	UMAX UC630	XRS 6C OmniMedia
	MicroArt II, Picture Publisher LE	*PhotoStyler*
	■ ■ ■ None	■ ■ ■ None
	■ 1 year ■	■ 1 year ■

ENDS

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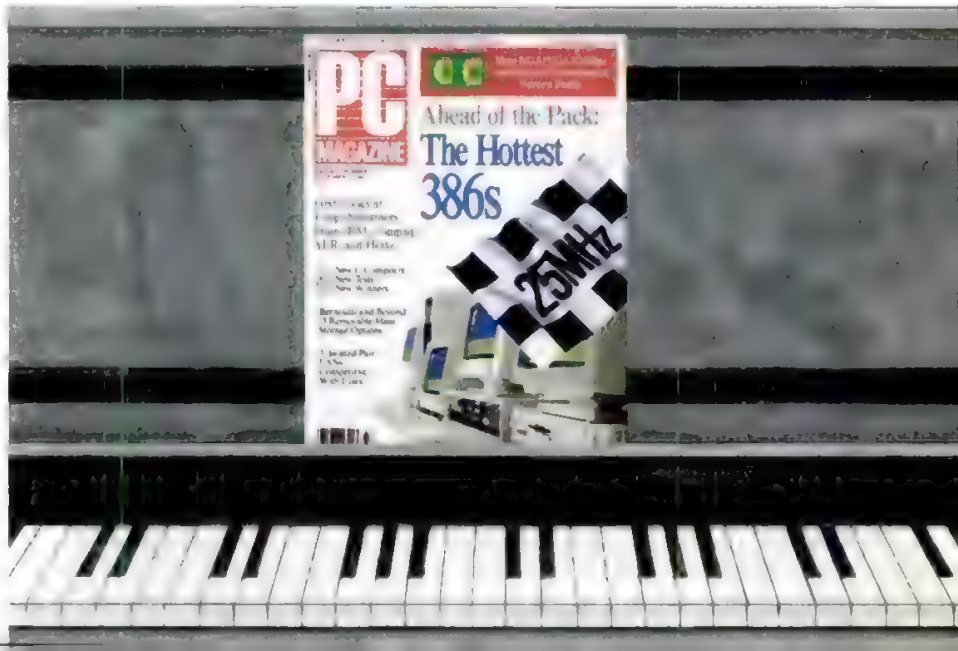

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eir Fingers To The Bone?

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CIRCLE 108 ON READER SERVICE CARD

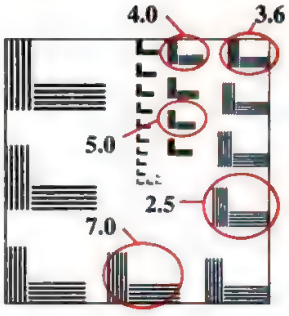
HOW WE TESTED

We tested all the scanners with the hardware and software in their default configurations, with calibration turned on if available; these do *not* represent the best scans possible. We judged each scanner on whether it could produce output that would be "good enough with minimal fuss."

All images were scanned at 300 dpi, and PDR PrePress Graphics—a New York–based graphics service—performed all color separations and output. The images were not color-corrected for analysis, but all were later corrected to compensate for the dot gain that occurs in printing the magazine. Because of scaling problems with *ColorLab*, the Abaton images have been cropped to fit the space allotted.

LINE-ART QUALITY

To judge the quality of a unit's line art, we scanned in two different images, both at 300 dpi and at the scanner's highest optical resolution, and printed them out on a Linotronic L330. Here we reproduce only the 300-dpi output, cropped to fit the available space.



The first target, available from Applied Image (Rochester, New York), is composed of several test elements. Part of the target measures the number of cycles per millimeter that a scanner can resolve (a cycle comprises a bar plus the following space). A larger number—more cycles per millimeter—is preferable. Horizontal resolution is more difficult to maintain than vertical, because the scan head moves vertically and can end up capturing only pieces of lines as the line size shrinks.

Other parts of the target include:

- text samples in a variety of point sizes, both horizontally and vertically oriented;
- distortion grids in the corners, which also help us check for uniformity of the light source at the corners of the scan bed;
- a circle outline, to check curve-scanning quality;
- a solid black square to measure density.

Our second target is the Gammatrol, available from Graphic Arts Manufacturing Co. (Houston, Texas). The piece shown here is cropped from a complex, detailed line drawing. Things to look for in the Gammatrol target are the number of lines in the white of the eye on your left—there should be approximately nine from inner corner to the pupil—and three concentric rings in the pupil. You should also be able to see the eye on the right and the eyebrow above it. The right side of the moustache should not look chopped off; the moustache continues past the subject's cheek.

The brightness level can be more important for scanning line art and text than for scanning gray scales. If the brightness is too high on a gray scale, the information will still be picked up and can be corrected after the fact. With line art, however, the brightness setting will affect whether a pixel is above or below the threshold, and therefore whether it will be picked up at all. For thin, closely spaced lines or text in small point sizes, increasing the brightness slightly will improve your image.

These scans were performed at the default settings; adjusting the settings could theoretically affect the results. For instance, resolvability might be improved slightly in some cases by adjusting the brightness level.

GRAY-SCALE QUALITY

To test the gray-scale quality of the units, we scanned three images. The first, which we used as a diagnostic tool when analyzing the output, is the Kodak Q60C Color Reproduction Guide, a photograph comprised of color patches and a "20-step gray-scale strip." Note that a scanner's performance on the strip scan is not an indication of the *number* of gray shades the scanner can distinguish, but an indication of the unit's tonal range.

The second image (not reproduced here) is a highly detailed multicolored mosaic, composed of highly saturated colors (especially reds, yellows, and blues), which stresses the scanner's ability to differentiate among dark gray levels. Inexpensive scanners tend to be weak at this.

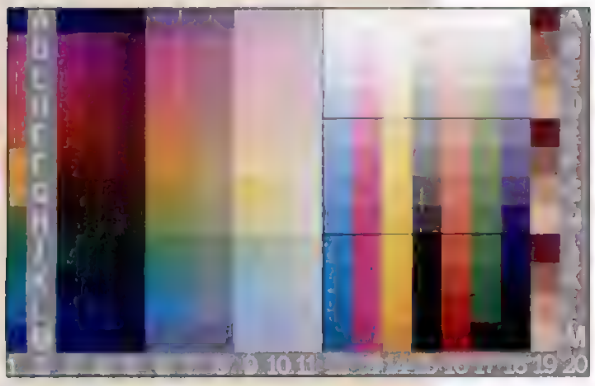
The third test image is a high-contrast photograph of a boat entering a harbor; it has areas of great detail (especially on the deck) and lots of highlights (the boat's reflection) as well as midtones and lowlights. We chose to have all the gray-scale images output using a Linotronic L330 at 1,200 dpi with a 100-line-per-inch halftone screen.

COLOR QUALITY

To test color quality, we once again scanned in the Kodak Q60C target. While the Q60C is designed for scanner calibration, it also proves helpful in diagnosing colors gone awry. The Q60C is structured as follows:

- *Columns 1–11:* Each row is a different hue. Column 1 represents neutral saturations; columns 3, 4, 5 are the same hues at three dark saturations; columns 6, 7, 8 are those hues at three medium saturations; columns 9, 10, 11 are those hues at three light saturations.
- *Columns 12–15* contain CMYK patches (cyan, magenta, yellow, and black) at lightness levels A through M.
- *Columns 16–18* contain RGB patches (red, green, and blue) at lightness levels A through M.
- *Column 19* contains skin tones.

As another casual diagnostic, we scanned the cycles-per-millimeter line-art target in 24-bit color mode to get a sense of the unit's color registration and balance. We also scanned three color photos. The first, a close-up of crayons, tests the scanner's ability to pick up highly saturated colors. The second is the same mosaic photo we scanned for the gray-scale tests. The third is of a boy partly in shadow, designed to test the scanner's ability to distinguish highlights and shadows. The latter two images are not reproduced here.



pass, before the ready light goes on. We judged the test output to be satisfactory.

With its default settings, the AVR 8000/CLX captures images that are mainly on the dark side. Though this may be because the unit is unable to apply calibration maps other than those provided by AVR, the image capture was consistently dark on all our test targets—black-and-white, color, and gray-scale. As a rule, gray-scale scans maintain good detail, but there is heavy CMYK color sampling that gives colors an oversaturated, muddy appearance. Separations done for the color files showed each of the four colors as extremely dark or heavy. It is too insensitive when scanning the color targets' lowlights, and magentas tend to be pinker than they should be. The AVR 8000/CLX performed well on the 300-dpi line-art scan of our Gammatrol test target. The scanner's tendency toward darkness works to its advantage here and on the 600-dpi full-page text scans, enabling it to produce excellent output. Nevertheless, close inspection of the scan of the MT-1 target shows that this scanner outputs curves poorly.

As a piece of hardware, the AVR 8000/CLX's engineering and operation match its high-quality, simple design. Setup and installation are quick and easy. The default IRQ and SCSI address settings, which are the only hardware controls besides a power switch, worked without a hitch during our testing. The cover seals the scan bed securely and is easily removed. Mechanically, this unit performs very efficiently, due to its Fast-Scan scanner controller (a processor built into the scanner) and image buffering. It routinely challenges the speed standards of the HP ScanJet IIc on nearly all of our color and gray-scale scanning speed tests. The speed differentials for 150- to 300-dpi scans are the lowest of all the scanners reviewed here, too.

AVR's attention to hardware details is represented by add-on products such as the $695 gray-scale-to-color hardware and firmware upgrade that makes their gray-scale scanners color capable, as well as the company's $795 100-sheet ADF 2000 automatic document feeder. In addition, the company is developing a transparency platform for its line of scanners and improved firmware to provide better control over the saturation of light colors. With revisions, maybe the software will measure up to the hardware's standards. Until then, the AVR 8000/CLX's speed cannot make up for its muddy color output.

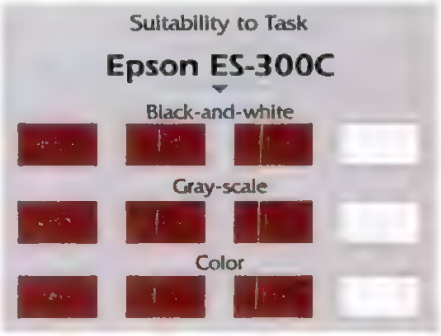
EPSON AMERICA INC.

Epson ES-300C

BY KELLYN BETTS The Epson ES-300C could well represent the shape of scanners to come. Externally, this surprisingly trim unit features both an honest-to-goodness user interface and hardware controls. Internally, the scanner features an innovative scanning apparatus capable of faithfully reproducing all manner of material. The Epson ($2,194 for the bundle) has everything you could ask for—except speed.

The interface board may not be a necessity, but it's a welcome addition. The bundled software—Micrografx's *Picture Publisher LE,* a black-and-white version of *Image-In-Color,* and CPI's *Color Lab* 4.0—will still override your hardware settings, but the interface will let you see how the software is interacting with the hardware. There is something comforting about this option, even if you're only seeing error codes or a reiteration of brightness and zoom settings.

Actually, the main reason Epson added the hardware controls is for use with the scanner's direct-print feature. This option sends photo images directly to your printer, in effect turning the scanner into a glorified copy machine. The ability to print



scans sets the Epson scanner apart from the others in this roundup, but it does not add much practical value.

Far more laudable are the scanner's gamma- and color-correction files, which you can use to optimize scans for different output devices. These correction filters are available in all the bundled software and can also be used with the direct-print feature. Epson's excellent manual describes and illustrates both features.

LAUDABLE OUTPUT

Of course, the ability to enhance scans counts for naught if the originals don't look good. That's not a worry with the Epson. Like the HP ScanJet Plus, its one-pass scanning method seems to eliminate registration problems. The Epson's approach is not identical to the HP scanner's, though: The two use different CCDs (charge-coupled devices) and lighting arrangements. The Epson employs a single-row CCD and three separate lights for the red, green, and blue hues used in color scanning. (For gray-scale and black-and-white scanning, scanners simultaneously light all the lamps to create white light.)

The flashing of the Epson's red and green lights seemed to combine and create additional yellow tones in our test color scans, but the scans were still usable. In fact, we rated all the Epson scans as very good; the unit produced the best output of all the scanners we tested.

The flashing of the Epson's red and green lights seemed to create additional yellow tones, but the scans were still rated as very good.

The scanner didn't exactly crank out these excellent-quality scans in record times. Plod and crawl are more appropriate words for describing the Epson's speed—and this is *with* the optional $299 bidirectional parallel interface board. (In the version we tested, the board was included in a $495 interface-kit package,

FACT FILE

Epson ES-300C
Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; 800-922-8911, 310-782-0770.
List Price: Scanner alone, $1,699. Bidirectional parallel interface, $299; with *ColorLab, Image-In,* and *Picture Publisher LE,* $495. Cable, $29.95.
Requires: 286-based PC or better, 2MB RAM, VGA display, Microsoft Windows 3.0.
In Short: The Epson ES-300C scanner—$2,194 in our tested configuration—takes up a minimum of desk space and can be relied on to produce great-looking scans. If you don't mind waiting a long while for output, you will find it the perfect scanner. At least its user interface will reassure you that it is plodding through the scanning process.

CIRCLE 461 ON READER SERVICE CARD

MONOCHROME OUTPUT QUALITY

In our testing, the Hewlett-Packard and Microtek scanners vied for the best line-art output.

While the Epson and AVR produced excellent scans of the line-art image, they both showed weakness in other areas; the AVR tended to scan too dark, reducing its ability to resolve closely spaced lines, and the Epson's vertical resolvability—which was worse than its horizontal resolvability—made it fare poorly in text scanning.

The UMAX produced excellent text, especially at 600 dpi, but its line-art image scan was slightly too dark, resulting in a slight loss of detail. On the other hand, while the Abaton showed generally good resolvability, its line-art image scan was far too light, resulting in substantial loss of detail.

The quality of line-art image produced by the Marstek MFS-3000C, a reincarnation of the discontinued Microtek MFS-300C, equalled that of the best line-art scanners, the HP ScanJet IIc and the Microtek ScanMaker 600Z. The page-length line-art scan, however, showed glitches in the places where the scan head paused as the scanner waited for the PC to catch up with it. (If you look closely, you may be able to see a wavy line in the text sample that illustrates the problem.) This is partly a function of the driver, so don't assume that the scanner is necessarily unsuitable for OCR; OCR packages use their own scanner drivers, which are optimized for scanning long pages of text.

Both the Howtek and the XRS tended to produce scans that were too dark. In both cases, this is most likely a result of not-too-finely tuned drivers, since both scanners produced better output when tweaked slightly or used with different drivers during casual testing.

Abaton Scan/300 Color

AVR 8000/CLX Color Image Scanner

Epson ES-300C

HP ScanJet IIc

Howtek Personal Color Scanner

Marstek MFS-3000C

Microtek ScanMaker 600Z

UMAX UC630

XRS 6C OmniMedia

along with the bundled software; the scanner alone costs $1,699.) You could save yourself some money by relying solely on the Epson's serial port, but considering the scanner's slow performance with the faster, parallel interface (it finished last on three out of five speed tests), we would not recommend you do this.

The speed issue is really the only thing that should dissuade you from buying this first and thus far only scanner from Epson. In addition to all its other fine qualities, a comparatively generous one-year warranty and ease of installation make this scanner one of the best you can buy. Stay posted for a potential SCSI-interface announcement that could make the Epson ES-300C a scanner for all reasons.

HEWLETT-PACKARD CO.

HP ScanJet IIc

BY MITT JONES The $2,195 HP ScanJet IIc has the same strong qualities that made the HP ScanJet and HP ScanJet Plus the most popular gray-scale scanners going: superior scan quality, field-leading performance, competitive pricing, and ease of setup and use. This 400-dot-per-inch, single-pass model is not without its minor flaws, but Hewlett-Packard Co. has gone far to make the ScanJet IIc an enticing buy, no matter what the application.

Past HP scanners have catered to the novice as well as the pro; the ScanJet IIc very much follows this tradition, beginning with installation. To determine the correct DIP switch settings for the proprietary 8-bit SCSI interface, for instance, you simply run an HP utility that polls your system and then illustrates the correct settings.

ONE TO SCAN, ANOTHER TO EDIT

Once you have run the automatic software installation, you will find two applications set up under Windows: HP's *DeskScan II*, which provides the scan functions, and an OEM version of *Publisher's Paintbrush*, which provides the image-editing capabilities. Scanning with one package and editing with another may

GRAY-SCALE OUTPUT QUALITY

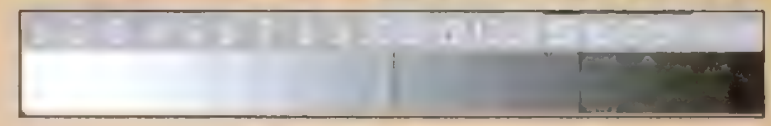
The Epson, HP, Microtek, and XRS units produced the best gray-scale output, with the XRS coming out slightly ahead because of its increased color sensitivity.

All of the best performers—the Epson, Hewlett-Packard, Microtek, and XRS scanners—had some trouble with lowlights (shadows), as scanners in this category usually do.

All but one scanner had problems with the scan of the mosaic photo; the exception is the Abaton, which, because of its tendency toward lightness, did a far better job at picking up the lowlight details. Overall, however, its output image was too light, with loss of detail in the highlights.

The AVR and Microtek scanners produced images that tended toward the dark side, but both would be usable with some minor adjustments. The UMAX, the Marstek, and especially the Howtek were very dark, losing much of the lowlight detail.

Abaton Scan/300 Color



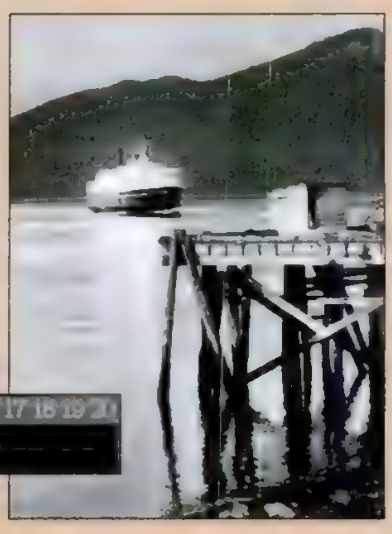
AVR 8000/CLX Color Image Scanner

Epson ES-300C

HP ScanJet IIc

Howtek Personal Color Scanner

Marstek MFS-3000C



Microtek ScanMaker 600Z

UMAX UC630

XRS 6C OmniMedia

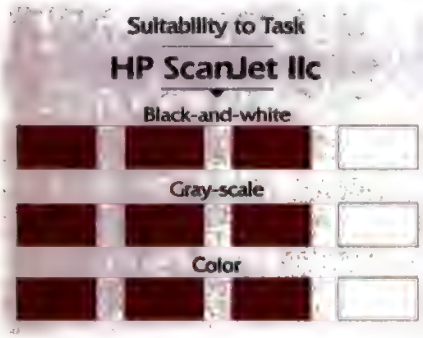
Past Hewlett-Packard scanners have catered to the novice as well as the professional; the ScanJet IIc very much follows this tradition.

prove annoying at times, but HP has done an admirable enough job with *DeskScan* to make the nuisance worthwhile.

DeskScan caters to the novices in the crowd by using simple nomenclature and including features such as the Automatic Exposure button, which automatically adjusts the contrast and brightness. Those with a trained eye will appreciate the live preview—*DeskScan* automatically applies your adjustments to the on-screen preview image as you go along—and the ability to adjust tonal range, midtone balance, and color hues and saturation. Even these features are easy to use and should encourage novices to develop their skills through trial and error.

The software also includes six different halftone patterns and a calibration routine for monochrome and color output devices. It supports direct printing of the monochrome or color calibration targets, as well as printing them to a file so you can calibrate for a remote device or for printing from a different application.

The package manages to accommodate both novices and experienced users without a great deal of conflict, but one resulting problem deserves note: *DeskScan* presents the available image types in language meant to be descriptive,



COLOR OUTPUT QUALITY

The AVR, Hewlett-Packard, Microtek, and XRS units fared worse than expected at their default settings.

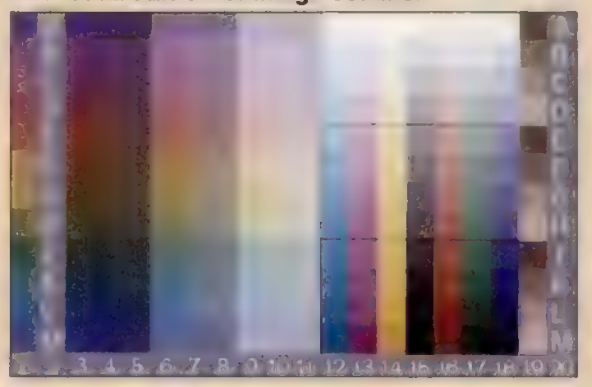
Four notable scanners produced overly dark output, resulting in some color shift and posterizing around the shadows. By contrast, the UMAX seemed to produce the best color output—slightly too red, but with excellent saturation and tonal balance. The Marstek also produced usable output.

Most of the scanners tended to be too sensitive to reds, resulting in color shifts. The Epson, which shines its green and red lights at the same time, displayed a shift toward yellow instead. It had good exposure, although the Epson's sensitivity seemed to drop off dramatically from light to dark.

Once again, our results for the Abaton and Howtek were undersaturated, with neither scanner ever obtaining a true black. In the Abaton's case, this resulted in very good detail in shadowed areas; the Howtek, however, did not seem to gain any detail in the shadowed areas, as one might expect from an overly light scan.

Abaton Scan/300 Color

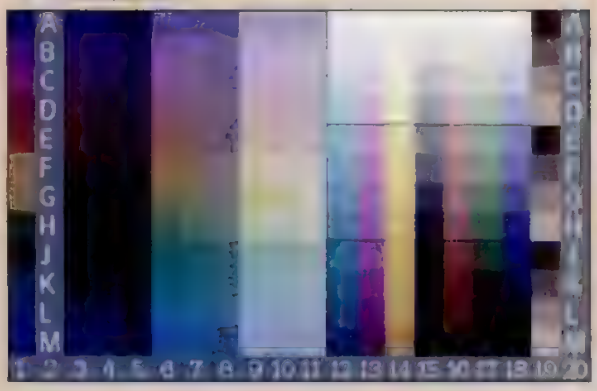
AVR 8000/CLX Color Image Scanner

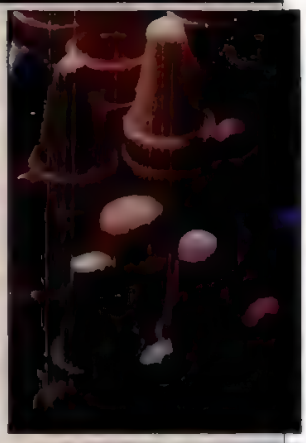


Epson ES-300C

COLOR OUTPUT QUALITY

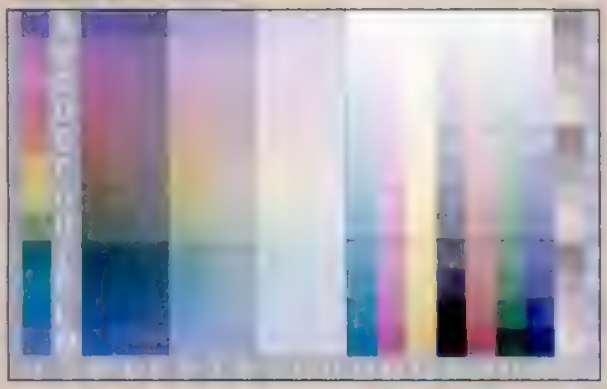
HP ScanJet IIc



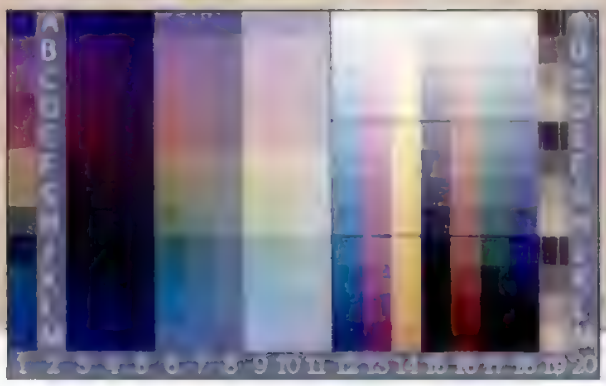


Howtek Personal Color Scanner

Marstek MFK-3000C



Microtek ScanMaker 600Z



but the choices can end up causing confusion. Admittedly, remembering that "color photo" means 8-bit color and "millions of colors" means 24-bit presents no formidable challenge, but this warm, fuzzy approach only obscures matters for anybody who has taken the trouble to read even a quick introduction to color scanning.

The documentation, or lack thereof, presents another drawback. HP's single manual does a good job of covering the basics of *DeskScan* and gives new users a helpful introduction to scanning issues. Once beyond the basics, however, you will have to refer to *DeskScan*'s on-line help. You won't even find a mention of *Publisher's Paintbrush* by name in the ScanJet IIc's manual, and HP provides no separate manual for the package. You will have to depend on the company's quick-reference card, which devotes two pages to the package, and the on-line documentation available within *Publisher's Paintbrush* itself.

SINGLE-PASS, WITH A TWIST

Like the Epson ES-300C, the ScanJet IIc employs a single-pass design, but HP has taken a different approach with its single-pass implementation. Rather than use a single row of elements and alternate between red, green, and blue light sources, the ScanJet IIc uses a three-stripe CCD (charge-coupled device), which dedicates

HP ScanJet IIc
Hewlett-Packard Co., 19310 Prune Ridge Ave., Cupertino, CA 95014; 800-752-9000.
List Price: With *DeskScan II, Publisher's Paintbrush*, $2,195.
Requires: 640K RAM (1MB recommended), VGA display, Microsoft Windows 3.0.
In Short: The HP ScanJet IIc is clearly the best of the field. Superior scan quality, sheer speed, and competitive pricing make this an enticing buy, no matter what the application.

CIRCLE 462 ON READER SERVICE CARD

one row of elements to each color. A system of filters and mirrors splits the white light from the two fluorescent bulbs into red, green, and blue components and directs each to the appropriate row of elements.

The ScanJet IIc supports line-art and halftone modes in both monochrome and color, 4- and 8-bit gray-scale modes, and 8- and 24-bit color modes. Optical resolution is limited to 400 dpi, but the scanner supports resolutions from 12 to 1,600 dpi in increments of 1 dpi via interpolation in hardware.

HP has added a feature in hardware that may prove a boon for OCR applications: The technology, dubbed AccuPage, uses automatic-intensity settings that reportedly improve accuracy on text with highlighted backgrounds, and it includes other logic that joins broken characters. Caere Corp. has already shipped a version of its $995 *OmniPage Professional* that supports AccuPage, and other vendors are sure to follow. By the time you read this, HP should be shipping a $695 50-page automatic document feeder.

SUPERIOR PERFORMANCE

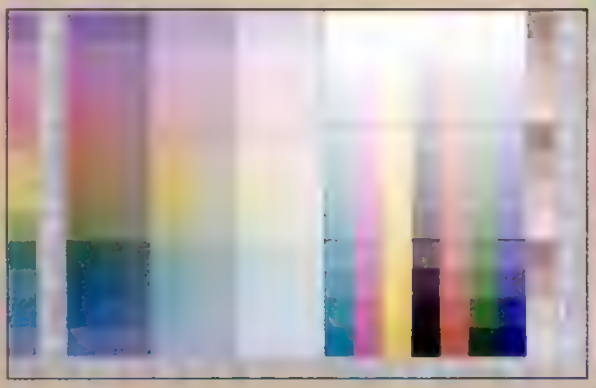
The ScanJet IIc performed well during all phases of PC Magazine Labs' testing. In terms of speed, this scanner led the field, ranking first in two of five speed trials and best overall. Some scanners, most notably the AVR 8000/CLX Color Image Scanner, kept roughly the same pace as the ScanJet IIc. The Epson ES-300C and a few others, however, failed to come even close. The ScanJet IIc completed our 150-dpi color scan in 22 seconds, for instance, while the Epson ES-300C required 102 seconds, and the Microtek ScanMaker 600Z required 146 seconds.

On tests of image quality at default settings, our evaluation unit's color scans suffered somewhat from oversaturation—a problem that is relatively easy for you to correct by altering brightness or color saturation—but even in this arena, the ScanJet IIc outperformed the majority of its competition. The scanner fared even better on line-art and gray-scale tests, generating images that were as good as or better than those of virtually all its competitors.

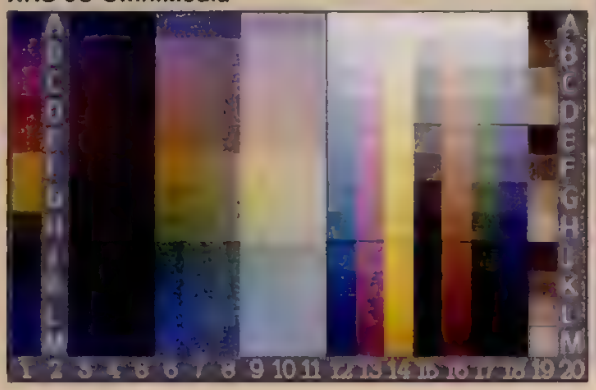
Its high scan quality and field-leading speed alone would make the HP ScanJet IIc an excellent choice for any PC desktop scanner application. Factor in the comfort of the HP label, the versatility and ease of use of the package as a whole, and a street price as low as $1,450, and it's hard to imagine a better buy.

COLOR OUTPUT QUALITY

UMAX UC630



XRS 6C OmniMedia



ENDS

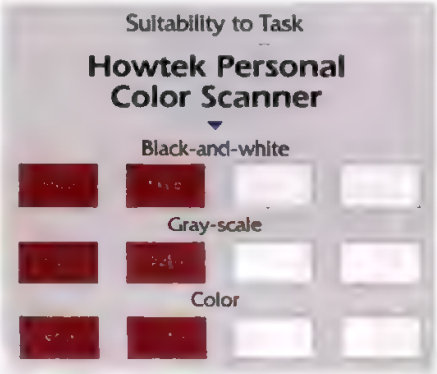
HOWTEK INC.

Howtek Personal Color Scanner

BY KELLYN BETTS When a scanner's only user-activated function is an on/off switch, it becomes dependent upon bundled software to implement its finer features. Our experiences with Howtek's inexpensive and spartan $1,295 Howtek Personal Color Scanner proved just how dramatically those software choices can affect scanner performance.

Howtek recently gave this large, two-year-old scanner a new lease on life by endowing it with a heavier cover and the ability to scan at 600 dots per inch. We tested the unit with *Picture Publisher LE.* Howtek also offers several different programs, including Mathematica's DOS-based *Tempra Pro,* the Windows-based *ColorLab* 4.0, and Adobe's *PhotoShop* for the Macintosh as part of its standard bundle. All are well documented and easy to set up, as is the scanner hardware.

From all indications, the *Picture Publisher*–Howtek team could be a great one—when all the bugs are ironed out. But as it happens, we tested a brand-new version of *Picture Publisher,* and the Howtek driver was not up to snuff. The scans we created at the default settings



Howtek Personal Color Scanner
Howtek Inc., 21 Park Ave., Hudson, NH 03051; 603-882-5200.
List Price: With *ColorLab, Picture Publisher LE,* or *Tempra Pro,* plus *WordScan,* $1,295.
Requires: 286-based PC or better, 2MB RAM, VGA display, DOS 3.01 or later.
In Short: The Howtek Personal Color Scanner is built to rely very heavily on the software commanding it. Choose your software carefully; it will largely determine how well the scanner operates.

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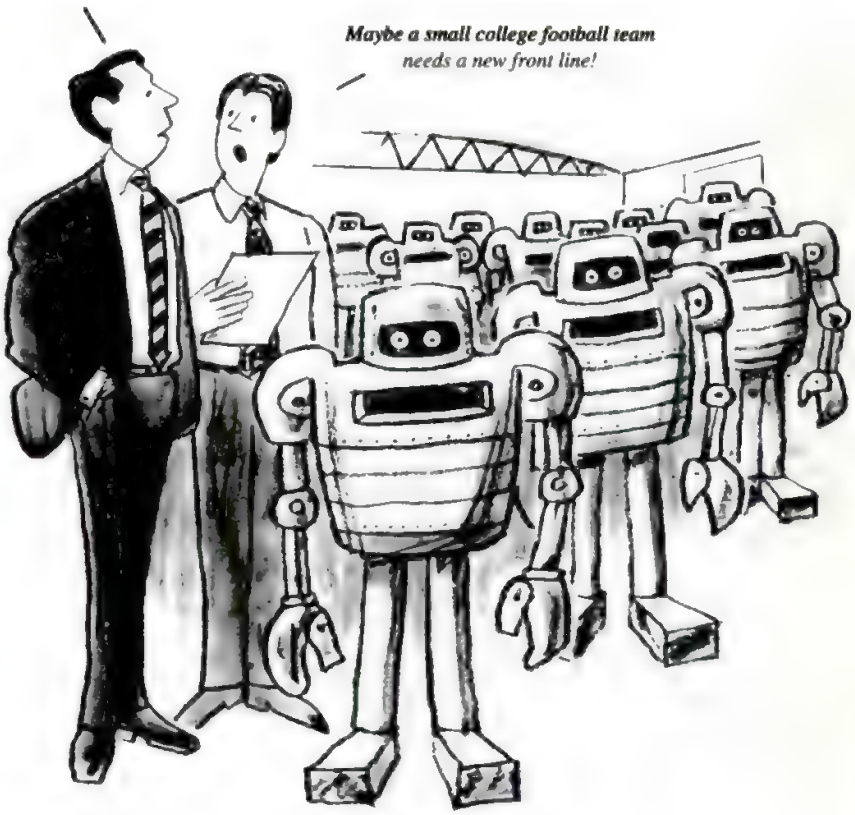
using *Picture Publisher* were not particularly good. We got better results during informal tests with *ColorLab* and *Tempra Pro. ColorLab,* in particular, created some very good-looking scans, though it required far more time than *Picture Publisher* to produce them.

UNUSUAL SPEED

Speed is the one thing (besides ease of installation) the *Picture Publisher* driver seems to have going for it. Even though the Howtek relies on a relatively slow bidirectional parallel interface, the software helped it race through most of our test scans far faster than the bulk of its peers, save the HP ScanJet IIc and AVR 8000/CLX Color Image Scanner. It is too bad that few of the resulting scans were of acceptable quality. The line-art and gray-scale scans were way too dark, failing to capture important details of the test images. The gray-scale scans exhibited little subtle-color sensitivity, losing highlights and lowlights. Ironically, the color scans had the opposite problem: They had been too light. In fact, they looked as if they had been shot through a fog. The color reproduction was adequate but, like the gray-scale output, was missing both highlights and lowlights.

Part of the problem is likely due to the fact that the Howtek scanner has no con-

What are we going to do with your extra robots, Fenton?



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PC LABS PERFORMANCE TESTS

The HP ScanJet IIc and AVR 8000/CLX Color Image Scanner compete for the title of speediest flatbed among the scanners reviewed here, with the ScanJet emerging as the fastest on the whole.

WHAT THE NUMBERS MEAN

Trying to isolate why some scanners are faster than others can be an exercise in frustration. The only general conclusions we can draw are about what we can *not* say.

First of all, faster is not necessarily better. A slower scanner may have compromised speed specifically so that it can more accurately re-create an image; the speedy Howtek Personal Color Scanner, for example, claims an accuracy of only 6 bits out of 8 in each channel. But as the HP ScanJet IIc results show, speed and quality are not mutually exclusive.

Likewise, we can't say that single-pass color scanning is necessarily faster than triple-pass: The two single-pass scanners, the Epson ES-300C and the HP ScanJet IIc, represent opposite ends of the speed spectrum. Unfortunately, it is difficult to isolate the elements that make a scanner fast, because so many factors affect speed. As with a graphics adapter, scanner speed depends heavily on the driver used and the bandwidth of the interface. Scanner performance is also complicated by how well the scanner synchronizes its data gathering with the computer's ability to process the data. Many of the scanners, for instance, pause during scanning to wait for the PC to catch up.

If you look at the results for the AVR 8000/CLX Color Image Scanner, the Howtek Personal Color Scanner, and the Microtek ScanMaker 600Z, the relative similarity between their 150- and 300-dpi scanning times—on both color and gray-scale tests—shows that their performance does not degrade much as you increase resolution. In the AVR's case, the 16-bit SCSI data path helps keep the PC's bus from becoming oversaturated. The rest have more trouble as they pass more data across the bus, but the HP ScanJet IIc is fast enough that you won't really notice. When scanning text at 400 dpi, however, the ScanJet takes only 50 percent longer than at 300 dpi, in contrast to AVR's 108 percent.

HOW WE TESTED

These tests reflect the time required for physically scanning the image, excluding the overhead introduced by the application

insofar as possible. We performed all the tests on Compaq 386/25e's with 300MB hard disks, using the default interface settings (where possible) and the default software package bundled with the scanner to drive the unit. In cases where the unit came with more than one package, we used the software selected by the vendor if it proved flexible enough to meet our testing needs.

We tested the Epson ES-300C using *Image-In-Color*, the HP ScanJet IIc using Hewlett-Packard's own *DeskScan* software, the Microtek ScanMaker 600Z and XRS 6C OmniMedia using U-Lead Systems' *Photo-Styler*, and the rest using Micrografx's *Picture Publisher LE*. We ran Microsoft Windows 3.0 in 386 Enhanced mode, with 2MB RAM allocated to SMARTDRV (with a minimum cache size of 1MB) and the remaining 5MB allocated to HIMEM.SYS, for a total of 8MB in the system. When the software provided multiple scanning speeds, we used the default, and we made sure that calibration was turned off.

Elapsed Time (seconds)
Lower scores represent better performance.

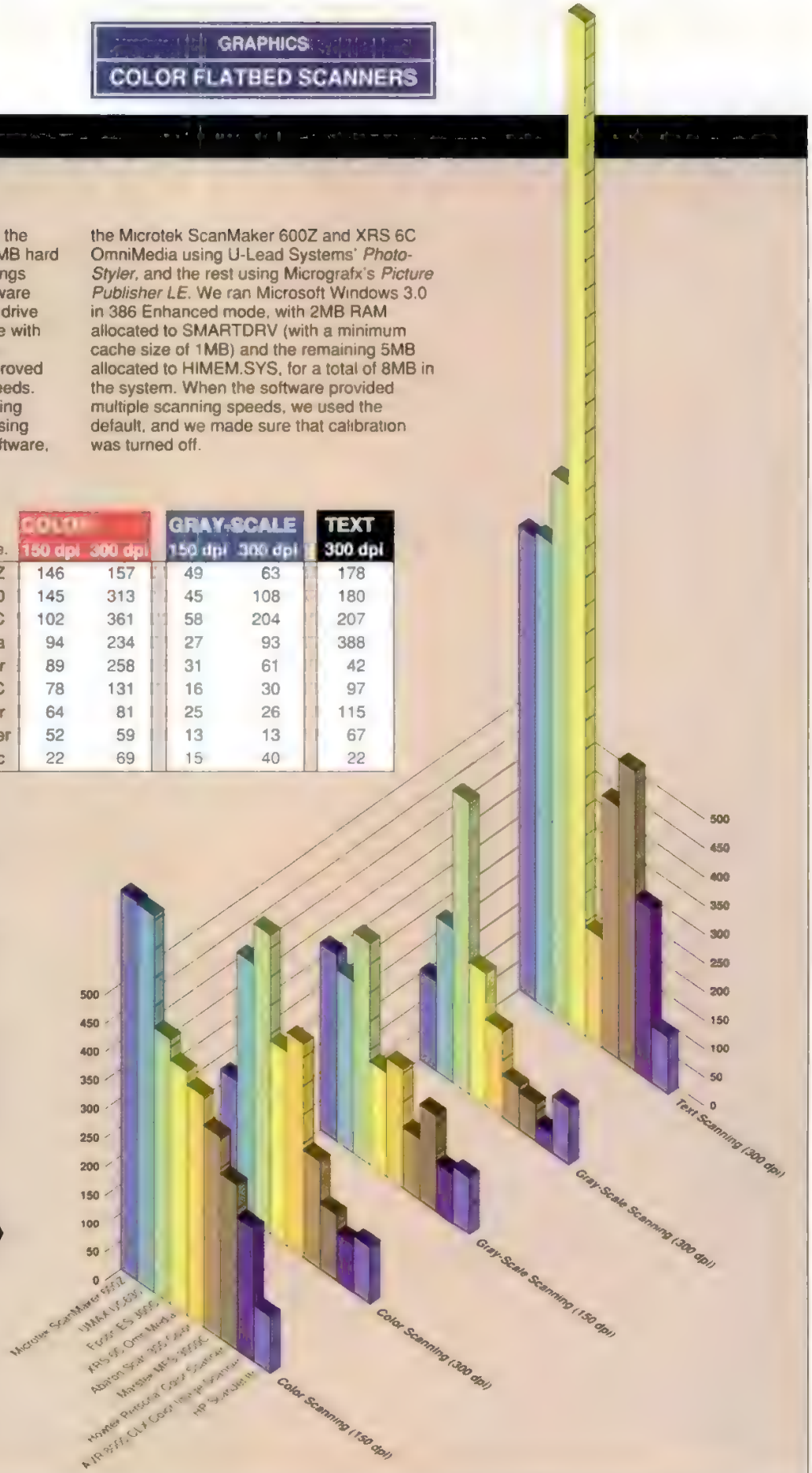
	COLOR		GRAY-SCALE		TEXT
	150 dpi	300 dpi	150 dpi	300 dpi	300 dpi
Microtek ScanMaker 600Z	146	157	49	63	178
UMAX UC630	145	313	45	108	180
Epson ES-300C	102	361	58	204	207
XRS 6C OmniMedia	94	234	27	93	388
Abaton Scan/300 Color	89	258	31	61	42
Marstek MFS-3000C	78	131	16	30	97
Howtek Personal Color Scanner	64	81	25	26	115
AVR 8000/CLX Color Image Scanner	52	59	13	13	67
HP ScanJet IIc	22	69	15	40	22

■ The **Color Scanning** tests measure the amount of time it takes to scan a 3- by 4.5-inch color photograph at 150- and 300-dot-per-inch resolutions.

■ The **Gray-Scale Scanning** tests measure the amount of time it takes to scan a 4- by 6-inch black-and-white photograph at 150- and 300-dot-per-inch resolutions.

■ The **Text Scanning** test measures the amount of time it takes to scan an 8.5- by 11-inch page of text at 300-dpi resolution. Because OCR packages come with their own scanner drivers, these results do not necessarily mirror those you might get with an OCR package; they do reflect the time it takes to scan a full page of line art.

Relative Times
(HP ScanJet IIc = 100)
Shorter bars represent better performance.



If you are intrigued by the Howtek Personal Color Scanner's low price and impressive reputation, choose your software carefully.

trol over brightness settings. This places the responsibility for controlling brightness on the driver's creator, in this case, Micrografx. If you are willing to spend some time making contrast adjustments, you should be able to overcome the darkness problem.

Another problem we encountered was the driver's failure to reset the scanner properly when switching between scanning modes—moving from line-art to 24-bit color, for example. This resulted in amazingly inconsistent scans: One gray-scale scan might be so black as to be unreadable and the next just slightly on the dark side.

Interestingly enough, even the far more expensive scanners Howtek makes—the company's top-of-the-line scanner retails for $39,700—are bundled with the same software. At review time, Micrografx was working on these particular problems, and Howtek vowed to completely revamp the driver as soon as the *Picture Publisher* driver toolkit is made available to scanner manufacturers.

If you are intrigued by the Howtek scanner's low price and impressive reputation, choose your software carefully. If you decide on the *Picture Publisher* bundle, be sure to get an updated driver. The quality of your scans depends on it. And keep in mind that the scanner comes with a one-year warranty, which should give you ample time to swap software if you need to.

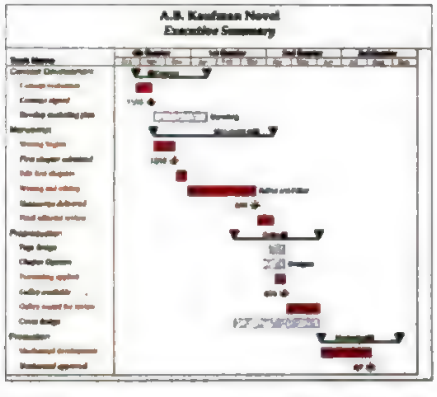
MARSTEK INC.

Marstek MFS-3000C

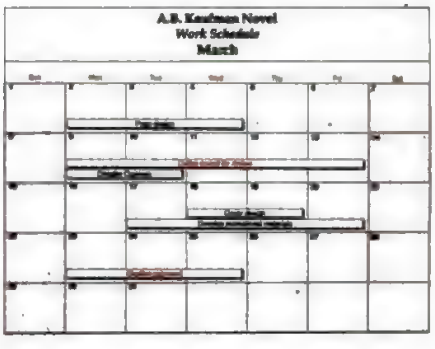
BY KELLYN BETTS After two years in the hand-scanner trade, Marstek decided to embrace the flatbed. The move is not as bold as you might think; Marstek is not going into the flatbed-scanner manufacturing business but has instead reincarnated a scanner previously sold by Microtek Lab. The result is a low-priced scanner that produces high-quality color output.

There is nothing original about the $1,295 Marstek MFS-3000C. It is merely a repackaged version of Microtek's five-year-old MFS-300Z that is bundled with

The CEO wants to know when it will be finished.



The staff wants to know when they can start.



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While it may demand more than its share of destop space, the Marstek scanner rewards users by scanning color images with impressive fidelity.

Perceive and *Picture Publisher LE.* (The original Microtek bundle included *PhotoStyler* instead.) The jumbo-size, 8.5- by 14-inch scanner works quite a bit faster coupled with *Picture Publisher* than with *PhotoStyler.* And now, probably because Microtek is no longer actively selling this model under its own name, Marstek is offering the scanner for substantially less than what Microtek demanded, even after the company had discontinued the model.

Compared with its peers, which grow smaller, slimmer, and lighter each year, the hulking Marstek looks larger than ever. But while it may demand more than its share of desktop space, the Marstek rewards users by scanning color images with impressive fidelity. The scans tend to have a bit too much red in them, but otherwise the color reproduction is surprisingly good.

GLOOMY GRAYS

Marstek's gray-scale and black-and-white output can't compare with its color scans. The gray-scale output, scanned at the default settings, is much too dark. You can no doubt remedy this situation by spending some time tweaking the scanner's generous selection of 14 brightness and 14 contrast controls.

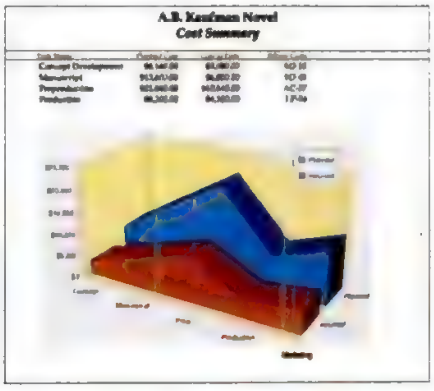
The black-and-white scans suffered from more than just too-dark default settings; they also show a serious bandwidth problem. Apparently, the Marstek's scan head paused several times as it made its

FACT FILE

Marstek MFS-3000C
Marstek Inc., 15225 Alton Pkwy., Irvine, CA 92718; 714-833-7740.
List Price: With *Perceive, Picture Publisher LE,* $1,295.
Requires: 286-based PC or better, 2MB RAM, VGA display, Microsoft Windows 3.0.
In Short: The Marstek MFS-3000C (a reincarnation of Microtek's defunct MFS-300Z) produces surprisingly good color scans at a reasonable price. The design may not be new, but this is a proven performer.

CIRCLE 464 ON READER SERVICE CARD

The controller wants to know how much it will cost.



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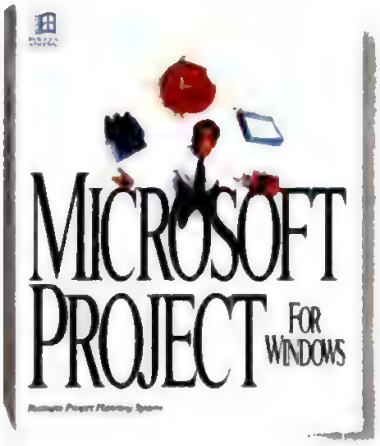

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If you are not afraid of using old technology, by all means consider the Marstek MFS-3000C. It's tried and true and a bargain to boot.

way down one of our larger black-and-white scan targets. (This occurs when the scanner has to pause and wait for the PC to process the reams of transmitted data.) The scanner has difficulty making certain that the scan head is in the right place when the scan head gets the signal to resume. If it's not, the result may be artifacts like the ones that were visible in our alphabet scan.

You probably don't need to worry about scan head registration difficulties when it comes to OCR work. OCR packages, like the *Perceive* software bundled with the Marstek, have their own drivers that are optimized for throughput. This makes OCR software less inclined to experience these types of registration problems. The scanner's current lack of an optional automatic document feeder is more of a stumbling block to using the Marstek for OCR work. At the time of this review, the company was considering adding a document feeder.

You can also expect a name change from Marstek. Last year, the company's name was Marstek, and next year it will be Mustek. This year, though, the company is using both names to ease the transition. The names are used interchangeably in the scanner's terse but adequate documentation.

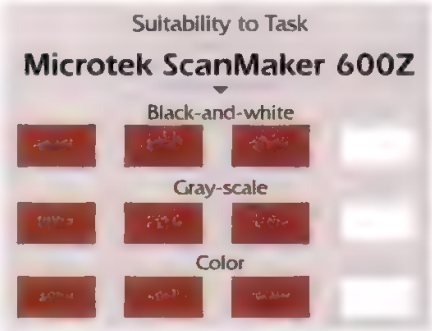
If you are not afraid of using old technology, by all means consider the Marstek MFS-3000C. It's tried and true and a bargain to boot. It may not be an original, nor is it a cutting-edge design, but this scanner is a steady performer.

MICROTEK LAB INC.

Microtek ScanMaker 600Z

BY MITT JONES You can't always judge a scanner by its speed. The $1,995 Microtek ScanMaker 600Z may rate mediocre at best in terms of speed, but its top-rate scan quality, bundled *PhotoStyler* software, and street price of about $1,400 make this legal-size flatbed model a bargain for applications that stress quality and economy.

The Microtek employs a straightforward three-pass design, using one white-light source and four filters: a neutral filter



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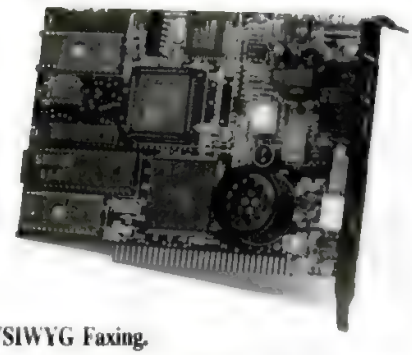

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CCITT V.42bis / MNP 5	√	√
CCITT V.42 / MNP 2, 3 and 4	√	√
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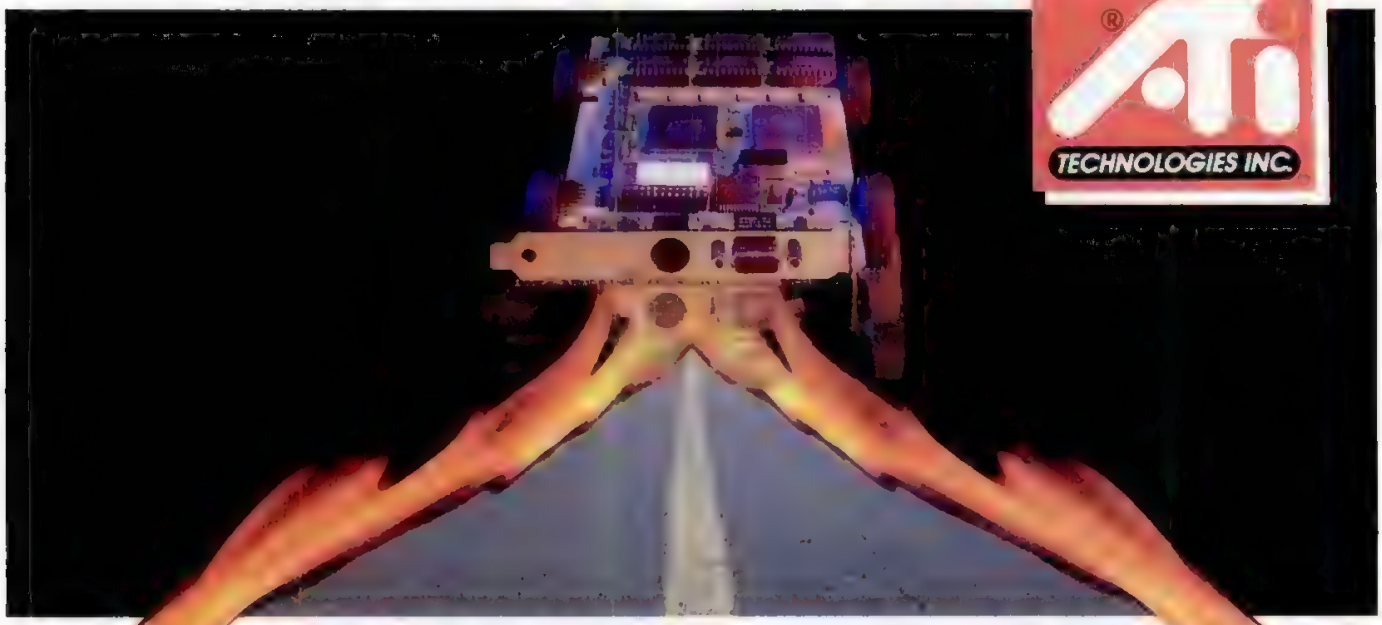

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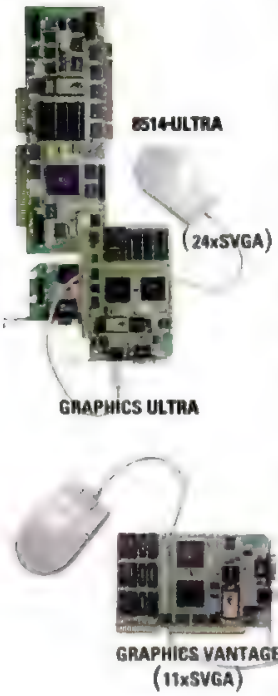

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CIRCLE 337 ON READER SERVICE CARD

When it comes to image-adjustment features, Microtek's scan module does not cater to novices, but experienced users may appreciate this approach.

designed to optimize gray-scale scans; and red, green, and blue filters. Despite its 600-dot-per-inch rating, the scanner employs a CCD (charge-coupled devices) with a 300-dpi optical resolution, reaching a hardware resolution of 600 dpi only in the vertical direction. To climb to resolutions as high as 600 dpi horizontally, the scanner depends on a pixel-averaging algorithm in firmware.

Installing the scanner is easy—once you figure out where to find the instructions. A slim user manual does an excellent job of guiding you through installation of the scanner and proprietary 8-bit video interface. Another thin manual, the Scanning Guide, does an excellent job of documenting the Microtek's scan module, which runs under *PhotoStyler*. It does not address software installation, though. Once you stumble onto chapter 2 of a third thin manual—*PhotoStyler: Getting Started and Tutorials*—you finally find out how to beat the problem.

SUPERIOR CONTROL

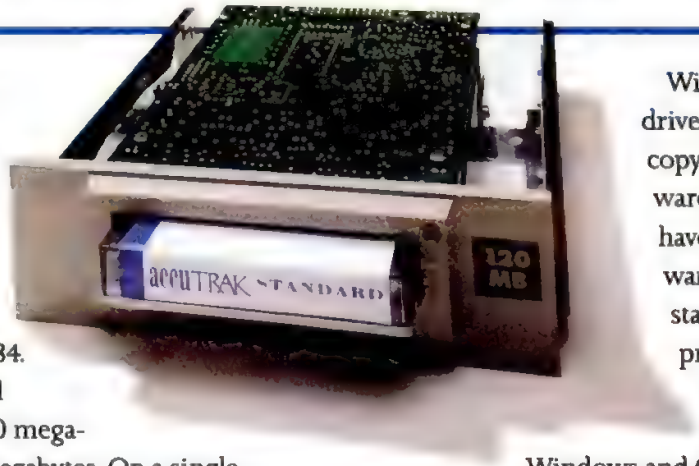
You access the Microtek scan module via *PhotoStyler*'s File menu. For basic scans, the scan module is as easy to use as any. When it comes to image-adjustment features, Microtek's scan module does not cater to novices to the extent of HP's *DeskScan II*, but experienced users may appreciate the different approach. The Shadow/Highlight tool, for instance, lets you adjust the brightest and darkest shades

FACT FILE

Microtek ScanMaker 600Z
Microtek Lab Inc., 680 Knox St., Torrance, CA 90502; 800-654-2160, 213-321-2121.
List Price: With *PhotoStyler*, $1,995.
Requires: 640K RAM, VGA display, Microsoft Windows 3.0. 4MB RAM, DOS 5.0, and memory manager recommended.
In Short: Though not a top performer in terms of speed, this three-pass scanner offers extended resolutions, high-quality image scanning, and enough power to satisfy even experienced users, all for a very appealing price.

CIRCLE 465 ON READER SERVICE CARD

At $249 It's A Great Buy.



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of the whole image as well as each color component. Similarly, the Microtek software allows freehand and incremental gamma adjustments using an all-color curve plus a curve for each color component.

Of course, the scan module also provides access to the Microtek's various scan modes, which include line-art, halftone, 8-bit gray-scale, and 24-bit color. Three additional modes, one for each RGB component, let you scan using only one of the color components.

One last scan feature deserves special note: When scanning in line-art or halftone modes, the Microtek lets you select as many as four subwindows from the single scan window, with each subwindow specifying an area that is to be scanned as either line-art or halftone art. If you scan in line-art mode, for example, the area within each window would be processed as a halftone. In halftone mode, each area would be processed as line-art.

SOPHISTICATED SOFTWARE

PhotoStyler itself offers a wealth of sophisticated image editing features, including the ability to produce color separations. Though developed by U-Lead Systems, the package has since been bought by Aldus, which has updated it and reissued it under the Aldus name. The package provided with our unit, Version 1.03, still bears the U-Lead label, but users should not fear being left out in the cold: Microtek offers technical support for the package, and Aldus should be offering upgrades to its own version by the time you read this.

The Microtek fared well on PC Magazine Labs' image-quality tests, generating images as good as or better than those of its peers on most trials. Like the HP ScanJet IIc, the Microtek suffered somewhat from oversaturated color scans, but this is a problem that you can easily correct by adjusting the brightness or color saturation.

The Microtek failed to keep up with the fastest of its competition when it came to speed, though, ranking among the slower scanners on most trials. Even here, however, there may be a partial cure. The Microtek scan module allows five different speed settings. Because a setting that's too fast for a given system can cause significant problems with image quality, we ran our tests at the default medium setting. As long as your system is fast enough to accept the data stream at the faster settings—which would keep the scan carriage from having to stop and restart—you should experience at least some speed improvements with little or

The Microtek fared well on PC Magazine Labs' image-quality tests, generating images as good as or better than those of its peers on most trials.

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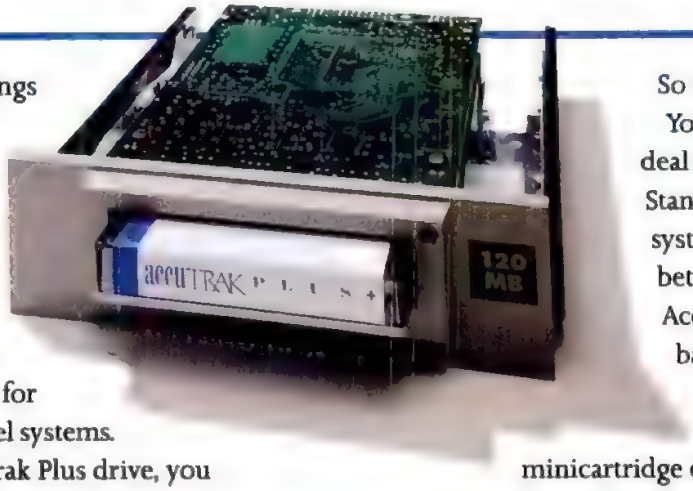

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The good news is that the UMAX UC630's line-art output is particularly good, though its color and gray-scale output are fair to average.

no drop in image quality.

Microtek Lab's optional $699 automatic document feeder was unavailable for evaluation at the time of our testing, but the company should be shipping the 100-page sheet feeder by the time you read this.

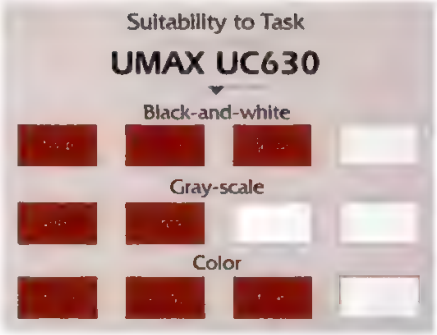
Given the Microtek ScanMaker 600Z's disappointing speed results on PC Magazine Labs' line-art scans, those interested primarily in OCR should probably look elsewhere. For those applications in which speed is a secondary consideration, however, the Microtek's attractive pricing and high image quality, the long presence of Microtek in the scanner industry, and the considerable power this package offers make it a color scanner well worth considering.

UMAX TECHNOLOGIES INC.

UMAX UC630

BY STEVEN C. M. CHEN Beneath its somewhat dull-looking exterior, the UMAX UC630 is a rock-solid 24-bit legal-size color scanner with an average color-scanning capability. Unfortunately, this competitively priced $1,995 scanner is adequate but far less impressive at gray-scale scans and downright disappointing when it comes to scan-time performance.

As the model number implies, the



UMAX UC630 offers a scanning resolution of 600 vertical by 300 horizontal dots per inch. The horizontal resolution is then interpolated to 600 dpi via software, the same way the Microtek and Howtek scanners do.

Setting up the scanner is a simple and straightforward process. (You will need to find a screwdriver to remove the shipping screw from the scanner, though.) Our test unit was equipped with an ISA 8-bit SCSI interface. An MCA version is also available. Setup is a strictly plug-and-play operation. Unless you have numerous other interface cards already installed, the default settings will work fine. The somewhat thin 44-page user

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UMAX UC630
UMAX Technologies Inc., 3170 Coronado Dr., Santa Clara, CA 95054; 800-562-0311, 408-982-0771.
List Price: With *MicroArt II, Picture Publisher LE*, $1,995.
Requires: 1MB RAM, VGA display, Microsoft Windows 3.0.
In Short: This three-pass legal-size scanner yields only average output at appallingly slow speeds. It's not the worst scanner in the crowd, but it has little to recommend.

CIRCLE 486 ON READER SERVICE CARD

manual provides ample information on setting up the scanner and changing the defaults, but the lack of an index can be a problem when you need to find answers in a hurry. Even with the skimpy manual, it should not take you more than an hour to install the hardware and software.

The scanner is bundled with two Microsoft Windows–based software packages: *Picture Publisher LE* and *MicroArt II*, UMAX Technologies' scan-and-paint program. *MicroArt* is for scanning line-art or halftone images. For our testing, we used *Picture Publisher LE*.

SLOW SCAN

The UMAX performed well, with one exception: speed, or the lack thereof. It was consistently among the slowest scanners in this review. Like most of its compatriots, the UMAX uses a traditional three-pass scanning scheme. During testing, it felt as though hours passed by while we waited for the scan head to return and start the next pass. This really comes as no surprise: The manual estimates the scan time at 160 seconds for a full-page scan at 300 dpi.

The good news is that the scanner's line-art output is particularly good, though its color and gray-scale output are fair to average. Careful analysis of our scan tests shows that the color tends to be well saturated but heavy on the red, while gray-scale scans are too dark, making it difficult to see the details. Our tests also showed that the higher 600-dpi resolution enhances the quality of scanned images but creates some problems: At this

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CIRCLE 293 ON READER SERVICE CARD

resolution, *Picture Publisher* had difficulty in scanning the full 8.5-inch width (and caused a not unexpected fourfold increase in file size). The reduced scanning width problem turned out to be *Picture Publisher*'s limitation.

The unit itself had a couple of problems. The three LED indicators (power on, ready, and busy) on the scanner's left side are so small that you may start scanning before the unit is ready. And like other UMAX models, this scanner offers no gamma correction; you will have to rely on software such as *Picture Publisher* for this.

Technical support is provided via a toll-free number. Be prepared, though, to reach voice mail rather than a real person at the other end. We had some trouble reaching tech support. As an alternative, you can try the company's 24-hour bulletin board; it is always available, but you will have to pay for the call.

UMAX offers two options for the unit: an $895 transparency attachment and a $495 25-page automatic document feeder.

Though the UMAX can produce usable scans, they are less than noteworthy. The quality of the output and the excruciatingly slow times it takes to produce it make this a tough product to recommend. The UMAX UC630 may not be the worst scanner on the market, but it's far from the best.

X-RAY SCANNER CORP.

XRS 6C OmniMedia

BY JAMES KARNEY The $3,500 XRS 6C OmniMedia looks a lot like the Microtek ScanMaker 600Z; in fact, it started life as one. But there are more changes than just switching the color of the unit from tan to black. The XRS is a dual-mode device with the ability to scan transparencies as well as reflective materials at resolutions up to 600 by 300 dots per inch in 24-bit true-color, 8-bit gray-scale, or 1-bit line-art modes.

The basic idea is simple and well implemented. X-Ray Scanner Corp. has placed a track along one side of the flatbed scanner's top. The light assembly is a removable bar that can you can take from inside the scanner, rotate 90 degrees, and fit in the track above the platen to provide backlighting for scanning transparent materials. This ability to pass light through the target image, just as you must transmit light through a slide in a projector, allows the XRS to scan transparencies.

The XRS is a cut above the average scanner, offering an excellent alternative to users who need to digitize both reflective and transparent media.

When the light assembly is fitted inside, the unit functions as a normal flatbed scanner. Making the transition from one lighting position to the next takes about 10 seconds; no tools are required. A keyed plug is used to assure proper alignment, and a sheet of ground glass holds the scan target flat.

You install and operate the XRS much the same way you do its Microtek cousin. You install a proprietary interface board (the same one used for all Microtek-based scanners), attach the cable and power cord, and then add a driver to your CONFIG.SYS file. We had the unit up and running in about 15 minutes with no problems.

EASY-TO-USE SOFTWARE

The XRS bundles the original U-Lead Systems version of *PhotoStyler*, rather than the most recent, Aldus-produced version. You can use the software to set the velocity; adjust gamma, contrast, and brightness; perform prescans; and define the area you want to scan. The options are easy to use and can be set with your mouse.

PhotoStyler is a full-featured true-color editing and paint program, with all the standard color/gray map correction, retouching, and paint tools. There are also a variety of filters for smoothing and sharpening and special effects for creating perspective shifts, distortion, motion, and rippling.

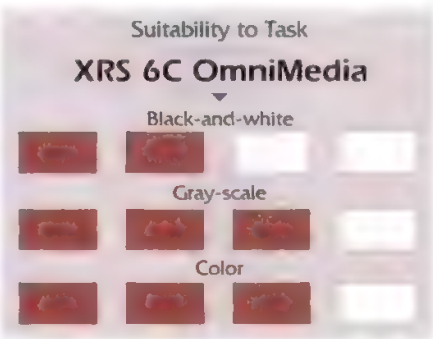
We encountered a problem when we tried to upgrade from the bundled software to Aldus's *PhotoStyler* 2.0. Aldus's Microtek driver could not drive the scanner under any other software, including the major OCR packages. We reloaded the XRS/U-Lead driver and all was fine until we tried to scan 8- and 24-bit images. Using *PhotoStyler* 2.0 with the U-Lead driver yielded an image that looked like a slide that was dried with a blowtorch.

TAKING A TEST DRIVE

The XRS is simple to use. It conducts a thorough built-in diagnostic and calibration test at the start of each scan. During this phase, a strip at the top of the platen is imaged and evaluated, the bulb and optical components tested, and any problems reported. Unfortunately, thoroughness is achieved at the expense of speed: The XRS turned in times that were no better than average. It tends to produce smoother scans with slower speed settings for 24-bit images. The test unit experienced some starting and stopping with high-speed settings at higher resolutions because the amount of data being passed to the PC was too much for the system to handle.

The company specializes in imaging equipment for medical and technical applications, where quality control is a prime concern. As a result, it has tuned the XRS to tighter tolerances than most units in this price range, and this scanner delivers enhanced CCD (charge-coupled devices) performance. One benefit of this extra engineering is a better dynamic range: 2.2 optical density (OD), compared with the Microtek's normal 2.0 OD. This increased dynamic range can give the final output better colors and shadow details. Depending on the quality of your original, it may also make gamma correction easier.

While the scanner certainly has enhanced capabilities, it still uses the *PhotoStyler* Microtek driver, so your scans at



XRS 6C OmniMedia
X-Ray Scanner Corp., 4030 Spencer St., Torrance, CA 90530; 310-214-1900
List Price: With *PhotoStyler*, $3,500
Requirements: 1MB RAM, VGA display, Microsoft Windows 3.0.
In Short: The XRS 6C OmniMedia may have started life as a Microtek 600Z, buts its improved dynamic range and additional calibration features make it more than just a clone. This scanner allows you to work with both transparencies and reflective materials by simply repositioning the light source.

CIRCLE 467 ON READER SERVICE CARD

the default settings will probably be disappointing—as ours were. The scanner produces excellent gray-scale output, but it tends to sample on the dark side in terms of color, for which its performance is only fair.

TRYING SOME TRANSPARENCIES

In addition to our standard tests, we put the unit through informal testing with 35-millimeter, 4- by 5-inch, and 8- by 10-inch transparencies. The 35-mm. slides did not yield high-quality images, but they were fine for use as comps to show a printer how to position halftones or separations. An Ektachrome 4- by 5-inch image scanned very well, looking better than an image produced from a print of the same shot. The same was true of a comparison of a pair of matching 8- by 10-inch Cibachrome images.

If you already have a Microtek ScanMaker 300Z or 600Z, you can upgrade to the XRS for $995 and $1,700, respectively. The XRS 6C OmniMedia is a cut above the average flatbed scanner, offering an excellent alternative to users who need to digitize both reflective and transparent media. The $3,500 price tag is a little high for a color flatbed, but if you need the dual-media capability, it's a lot cheaper than buying two scanners. ■

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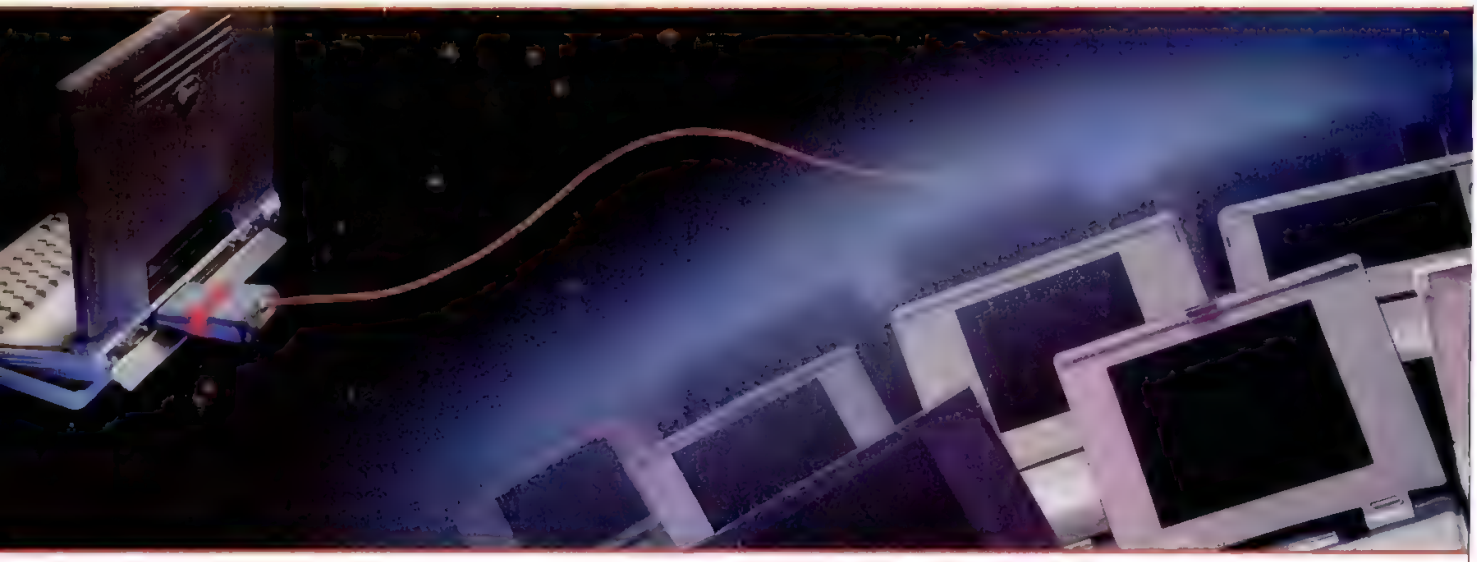

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LAN Fundamentals

PHOTOGRAPHY THOM O'CONNOR

Part 2

Low-Cost LANs Grow in Features and Performance

These 11 low-cost LAN packages let you connect an organization for less than $375 per node. Their functionality and speed may give some high-end network operating systems a run for their money.

Whether you are carrying out the computing plans of a small company or adding a workgroup to a corporate network, low-cost LANs may be the right choice. Once the simpletons of networking, these products have grown into full-fledged network operating systems sporting fast file and print services, significantly improved control over printing, electronic mail, and internetworking support. And these prod-

ucts will not break your budget. A typical group of ten PCs can be connected for under $375 per node, plus the cost of cabling. That's about half the cost of an average installation of one of the more powerful network operating systems, such as *LAN Manager, NetWare,* and *VINES.* In addition, low-cost networks can be installed by anyone who understands the concept of DOS subdirectories and is not afraid to take the cover off his computer.

Low-cost LANs have their drawbacks, however, and they might not meet the needs of a large installation, particularly in terms of administration and security. But for the small workgroup, the low-cost LANs reviewed here offer competitive solutions. *PC Magazine* recommends careful examination of the features and performance of these products before investing in their higher-priced cousins. For a general explanation of LANs, see the first part of our LAN tutorial, in the previous issue ("Connectivity Simplified: An Introduction to the Ways of Networking," March 31, 1992). Stay tuned for upcoming coverage of non-DOS-based network operating systems such as *LAN Manager, NetWare,* and *VINES.*

Artisoft's *LANtastic* and Performance Technology's *POWERLan,* our two Editors' Choice products, continue to lead the pack in performance and features. *LANtastic* gives you just about every feature you can get from these products, but it has limited capabilities for entering into an extensive corporate LAN. *POWERLan* has as many positives, plus better internetworking capabilities.

The acquisition of *10NET* by Tiara Computer Systems has breathed new life into this product in the form of improved menu systems and excellent control over print jobs. The current version of *10NET* deserves an honorable mention.

Novell has also introduced a popular contender into this market: *NetWare Lite.* But Novell's new release suffers because of an unwise copy-protection plan and limitations on the number of PCs per network, and some applications designed for *NetWare 2.x* and *3.x* will not work over *NetWare Lite.*

In all, we looked at 11 products: *GV LAN/OS,* from Grapevine LAN Products; *LANsmart,* from D-Link Systems; *LANstep,* from Hayes Microcomputer Products; *LANtastic,* from Artisoft; *MainLan GTi for Windows,* from MainLan; *NET/30,* from Invisible Software; *NetWare Lite,* from Novell; *Network-OS Plus,* from CBIS; *POWERLan,* from Performance Technology; *SilverNET,* from Net-Source; and *10NET,* from Tiara Computer Systems.

REVIEW CRITERIA

Before we arrived at this selection of low-cost LANs, PC Magazine Labs identified over three dozen products that provide inexpensive connectivity. To meet our criteria for testing, the products had to provide virtual-file and printer-sharing services for multiple PCs; the printer or disk drive shared over the network had to appear to DOS as a local resource such as drive F: or LPT2. This requirement eliminated products that just provide printer sharing. We also ruled out products that work only in the foreground or that can connect only two PCs at a time; such

HIGHLIGHTS

- Many low-cost LANs now offer advanced features, such as improved printing control, electronic mail, internetworking support, configurable memory requirements, and a Microsoft Windows interface. But they often skimp on administrative and security features.
- In networks of about a dozen PCs, low-cost LANs usually will not provide performance significantly different from that of high-end network operating systems. But in networks of 100 PCs and when running intensive applications (such as database programs), expect the high-end systems to deliver performance several times greater than that of the low-cost.
- While interoperability with *NetWare* can be a useful feature for a low-cost LAN, the products that include this support can require large sacrifices in RAM to give client PCs access to the *NetWare* servers.
- Many low-cost LANs now work with standard network adapter cards and cabling. If you decide to upgrade to a high-end network operating system later on, you will often be able to use the same hardware; it is a good idea to plan ahead before buying your hardware.
- Support for the Server Message Block (SMB) protocol allows some low-cost LANs to interoperate with *LAN Manager* and Unix servers. But since SMB implementations vary widely, SMB support is not a guarantee of interoperability.
- Many products give you the option of adjusting the server's CPU time to increase the amount of power the server devotes to running the network software, as opposed to performing local applications. An 80386- or 80486-based system should let you do this and still run the applications.
- Buying hardware and networking software from the same vendor often makes installation easier. If you buy from separate vendors, make sure you install drivers that will be compatible with both hardware and software.
- Differences between peer-to-peer and dedicated-server systems are evaporating as products straddle the two categories to a greater extent. But you can still expect better performance when running your network from dedicated servers than when also running applications on the server.
- Built-in hard disk caches often prove faster than add-ons, and write-through caches offer advantages over those employing read-ahead techniques. Efficient implementation of the NetBIOS transport protocol also helps optimize performance. Artisoft's *LANtastic,* Performance Technology's *POWERLan,* and Net-Source's *SilverNET* are three low-cost network programs that take advantage of caching and NetBIOS features.
- Hayes Microcomputer Products' *LANstep* provides a unique graphical interface based on rooms and offices, but it requires trade-offs in performance and efficient memory use.
- Although Novell's *NetWare Lite* offers a smoother migration path to higher-end versions of *NetWare* than Novell's previous entry-level system, it contains inherent drawbacks, such as network limits of 25 nodes. *NetWare Lite* also does not support the Novell Bindery or Novell's SPX protocol. ■

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Network Your Office In Less Than An Hour!

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Easy Office Network makes connecting PCs as easy as plugging in a new phone!

It seems everyone wants to connect up their computers—it's the hottest topic in computing today. Being able to share an expensive laser printer or high-speed modem can be a big money-saver. Not to mention the increased productivity gained by sending electronic messages between PCs. Then there's the advantage of quickly and easily transferring files. How many times have you tried to transfer a file that's too large to fit onto a disk?

Now you can easily—and inexpensively—reap the enormous benefits of networked computers—without experiencing the little-known hassles. Expensive networks like Novell require high-priced, expert technicians to perform even the simplest, everyday tasks. And big networks require special versions of your existing software. That's a big hidden cost! You could easily spend thousands of dollars just to connect a handful of computers.

That's why Easy Office Network has become such a hit here at Tiger. Everything you need is in the box, there's nothing else to buy, and you can run your existing software. Just unpack the box and you're on your way to a successful installation. Anyone can connect Easy Office Network—it's remarkably simple. And most importantly, everything's included—cables, connectors, user's guide and switching unit. The wires and plugs look just like phone connectors, and are just as simple to use. Once you've connected your PCs (in less than an hour!) Easy Office Network takes care of itself with no further attention. You're connected!

Here's what the amazing Easy Office Network can do for less than $99 per PC:

Share Serial and Parallel Printers with Disk Spooling: Printing with Easy Office Network is completely transparent; you simply print from your application as you normally would. Your print job is spooled (so you continue working) to your hard disk, so you can go on to other business.

Share Expensive Modems: Any of your Easy Office Network-ed PCs can call out through a shared modem. In addition, a remote PC can call in through the modem and be connected to the PC of their choice. Once connected, the remote PC can run applications on the networked PC!

Send Messages Between PCs: Speed up office communications with a mailbox-like message service. Easy to use, yet powerful electronic messages eliminate costly hand-delivered memos, updates and messages.

When you throw in password security, file locking, and a host of other features, Easy Office Network becomes a vital business solution no office should be without.

Start with the 4-PC or 8-PC kit, then add on when the need arrives. Multiple Easy Office Networks easily link together to support 16, 24 or 32 PCs. And don't worry about memory — Easy Office Network uses only a scant 48k.

All you do is plug the Easy Office Network connector into the serial port (which every PC has), and run the simple installation program. No boards or other hardware to install. No expansion slots taken up, and no conflicts with other boards. This product really lives up to its name: Easy.

Print as usual from any program — WordPerfect, Windows or Lotus 1-2-3 — and Easy Office Network sends the job to that expensive laser printer in the next room. What? Someone else is already printing on the laser? Don't wait — relax. Easy Office Network automatically spools the print job in the background so you can move on to your next task.

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Remote Power On/Off detects incoming calls and turns on the power for the PC, modem, printer and other peripherals that are plugged into it. But Remote Power On/Off isn't just for computers. It's also great for fax machines, laboratory equipment, data-gathering devices, or any other device you need to power on and off remotely. In fact, it's uses are as limitless as one's imagination.

Just a few of the new Remote Power On/Off enhancements include:

- **Power On Ring Counter.** Select how many rings before power is turned on. Ideal for sharing voice lines.
- **On Hook Delay Timer.** Select how long power will stay on after you hang up. Great for call-back features of pcAnywhere and Fax96.

Go Home. Your Computer Will Turn Itself Off When It's Done.

Introducing the brand new Intelligent Power Module (IPM for short). Plug it into the wall, then plug your computer into it and you have a new lifelong friend. A friend that will stay late and turn off your computer for you after you've gone home.

How does it work? A little cable runs from the IPM to either the serial or parallel connection of your computer. Then a simple "Power Off" command does the rest. Or use the special "Countdown" command for time-delayed shutdowns (up to 9 hours in advance). Or put these commands into a DOS Batch file for customized operations.

With this smart little addition to your computer, you can save those long computing jobs for after-hours. Without the risk of leaving your computer on all night. (I left my computer on one night and a lightning storm started up around midnight. I didn't sleep all night.)

SERVER TECHNOLOGY

REMOTE POWER ON/OFF	
BBJ6300 Remote Power On/Off	$149.95
INTELLIGENT POWER MODULE	
BBJ6302 Intelligent Power Module	$59.95
EASY OFFICE NETWORK	
BBJ6301A Easy Office for 4 PCs	$399.95
BBJ6301B Easy Office for 8 PCs	$495.00
BBJ6301C Upgrade from 4 to 8 PCs	$229.00

Remote On/Off: IBM PC, XT, AT and compatibles with 256K RAM
Easy Office Network: Requires 1 serial port for each PC

products offer solutions for some users, but are not the focus of this review.

We also required that the products work over industry-standard network adapters that conform to the Institute of Electrical and Electronics Engineers (IEEE) 802.3 (Ethernet) or 802.5 (Token-Ring) specifications. We allowed ARCnet cards, a de facto if not IEEE standard. If you want to move up to a larger LAN someday, or if you want to bridge to another LAN segment in your company while still running what you bought today, you need an industry-standard network card. Since a good Ethernet card costs less than $200, we see no reason for proprietary cards.

This requirement eliminated *ChosenLAN*, from Moses Computers (408-358-1550), and the nonstandard but lower-cost adapters sold by Artisoft and other companies. It also ruled out file-transfer products that use the serial or parallel ports for data transfer.

We stipulated that the cost per user for a six-user configuration, including a network card, could be no more than $375; cost is the primary aspect that sets these products apart from *LAN Manager*, *NetWare*, and *VINES*. Different packaging and price plateaus and common hardware make comparing prices tricky, but the software for *LAN Manager*, *NetWare*, and *VINES* will cost roughly twice per node what these products cost. High-end network operating systems range from $500 to $1,000 per node for the hardware and software, in addition to cabling costs.

Finally, since network operating systems are rapidly evolving, the products had to have been through a significant revision in the past 18 months. Among the companies that lacked an updated version of their product are Accton Technology (415-226-9800), Compex Corp. (714-630-7302), DNA Networks (215-296-7420), Solid Technologies (310-785-0030), and Web Corp. (415-331-1449).

Solid Technologies makes a low-cost LAN based on an earlier version of *Network-OS Plus*. The product is currently being revised and we expect the new version to be comparable with *Network-OS Plus*.

Web's product is a particular loss to this review, because it runs over Novell's IPX and provides useful interoperability with *NetWare*. Both American Research Corp. (213-269-1174) and Northnet Research (416-829-4064) released new products after our testing began.

Sitka Corp. (510-769-9669) sells the same version of the *10NET* software that Tiara markets but does not bundle it with network cards, as Tiara does. We will look at *TOPS* in our upcoming coverage of PC-to-Macintosh integration.

LOW-COST LAN BENEFITS

It is important to ask what you gain from settling on one of these products, besides lower prices. These products offer much greater flexibility in the distribution of resources than high-end products. With low-cost LANs, you can put shared printers and shared hard disks anywhere. For groups of a few dozen clients, low-cost LANs also offer easier installation and simpler administration than their higher-priced cousins. They can satisfy the needs of a typical office network with dozens or even as many as a hundred clients running word processing, spreadsheet, and small database applications. Note that *LANtastic* and *POWERLan* have excellent file-server performance for larger groups of client PCs. These products can distribute shared printers at convenient locations throughout the office, something that is awkward to do with the more complex products. Low-cost LANs also provide adequate security and reliability.

In a network of a dozen PCs running typical office applications, users will not perceive a performance difference between products such as *LANtastic*, *NET/30*, or *POWERLan*, and more expensive alternatives such as *NetWare* 3.11. But under the load of a hundred PCs sending

PINNING ON LABELS: Peer-to-Peer vs. Dedicated Server

by Frank J. Derfler, Jr.

As networking software products evolve, it has become increasingly difficult to pin simple labels on them. Although the terms *peer-to-peer* and *dedicated server* are still used, they have lost much of their meaning. In a traditional peer-to-peer network, any PC can act as a server, sharing resources such as hard disks and printers across the network, and any PC can act as a client to all servers. As a peer, any PC can act as a server and can run applications such as spreadsheets and word processing programs at the same time.

Before OS/2, the PCs in peer-to-peer networks typically used DOS as an underlying disk operating system; the software was typically inexpensive and less powerful than that of dedicated-server systems. Today, you can set up peer-to-peer networks running over DOS, OS/2, Unix, and other powerful operating systems such as Digital's VMS and using networking software based on *LAN Manager* or Sun's Network File System (NFS). *Peer-to-peer* no longer connotes DOS, low power, or low cost.

In a dedicated-server network, one or more computers assume the roles of file, print, and communications servers and that is all they do: Dedicated servers cannot run local applications. But in the real world, you can set up any *NetWare* file server to run application programs (although *NetWare* is traditionally thought of in the context of dedicated-server systems). Like *peer-to-peer*, the phrase *dedicated server* has lost some of its punch.

It does make sense to divide networking software products into those that use DOS as the underlying operating system on the server and those that use some other file-handling structure, often related to Unix. Products such as *LAN Manager*, *NetWare* 2.x and 3.x, and *VINES* use something other than DOS to handle files and provide a true multitasking environment for the networking software.

For the most part, the low-cost products in this review use DOS on the server, primarily because DOS-based products are less costly to field and support. But Hayes Microcomputer Products' *LANstep* uses a unique proprietary operating system on any PC acting as a server, and Performance Technology gives you the option of establishing a high-performance dedicated server under *POWERLan* using proprietary file-handling code. ■

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More users have chosen 10NET to network their PCs than any other peer-to-peer network operating system available. Sitka 10-NET 5.0 lets you share files, printers and databases directly (peer-to-peer) with others in your office, all with the point and click ease of Windows. 10NET can be as simple or as sophisticated as your business requires. In fact, it's powerful enough to be used by the U. S. Air Force and FBI, yet so easy to install and use that a two-person office could be networking in no time. And, unlike other peer-to-peer networks, 10NET lets you add up to 300 users per network to your workgroup.

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Call 1-800-445-8677 for the Sitka dealer nearest you. Try Sitka 10NET 5.0 today, and find out why over 650,000 users have made 10NET the #1 peer-to-peer network for Windows and DOS.

1-800-445-8677

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entries to a database held on the server, the multitasking operating system in *NetWare* 3.11 will provide performance several times faster than that of a DOS-based server.

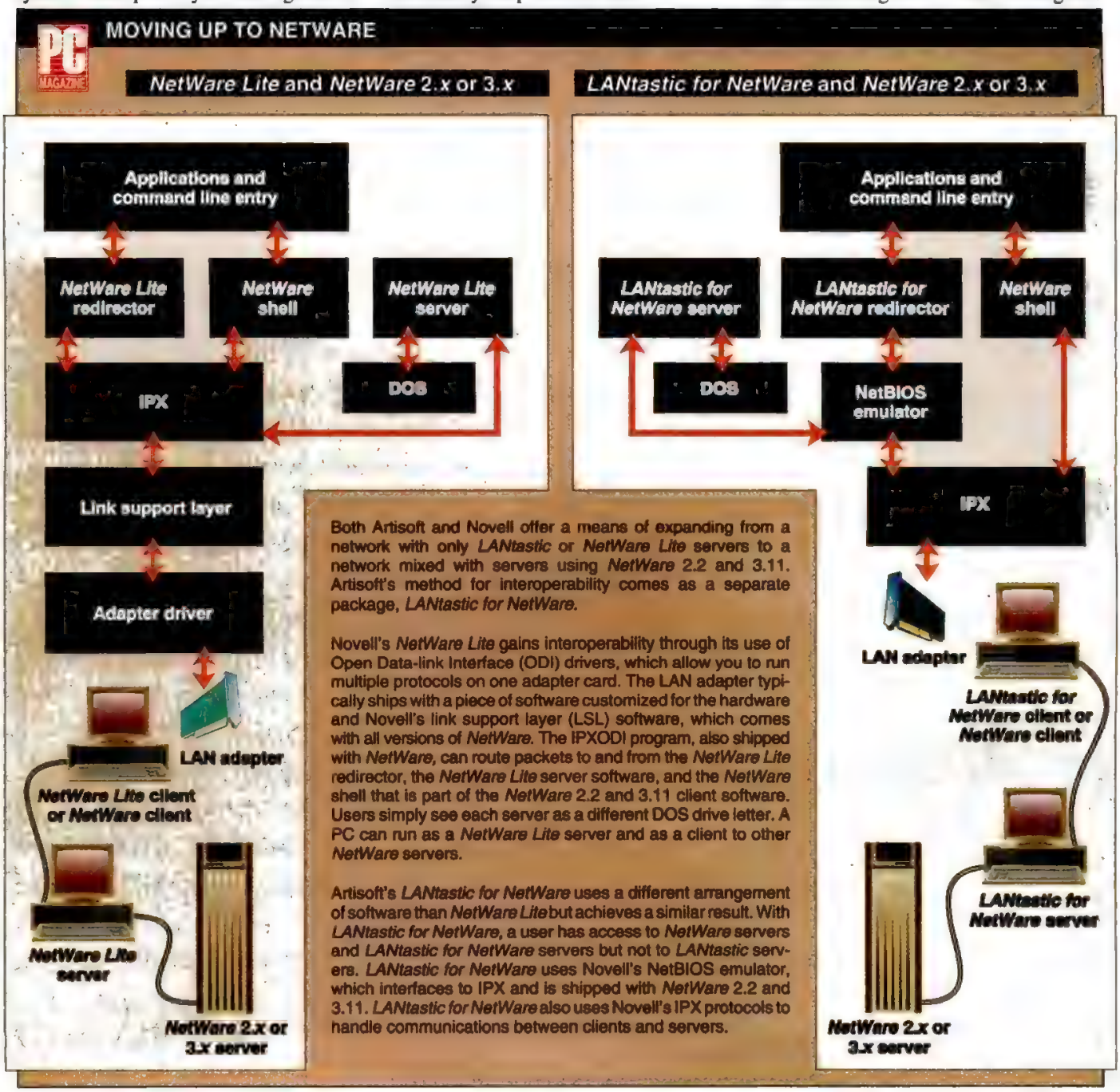
Many people like the fact that unlike larger and more complex systems, these low-cost LAN products generally let you run a network without the administrative burden of security limitations. Or, if you have only one hard disk with sensitive information such as payroll data, you can protect that hard disk or a subdirectory with a password and leave the rest of the system wide open. If you need tight security, you can weave a complex and effective system of multiple passwords. But eventually, security on these products becomes more difficult to administer than the comprehensive security systems in *LAN Manager, NetWare,* and *VINES.*

Both DOS-based and non-DOS-based LANs run over the same standardized hardware, so installing cabling and buying adapters for these LANs will not waste money. If you are not satisfied with the software you have, you can set it aside and confidently keep the hardware.

LOW-COST LAN DRAWBACKS

The low-cost LAN products reviewed here suffer some drawbacks. They lack sophisticated network management and administration, and they do not deliver fast performance from the server under the load of dozens or hundreds of clients. They also do not offer Macintosh support and cannot run sophisticated client-server applications such as a database server.

Low-cost LANs also contain some potential operational and administrative problems. While server programs typically block one Ctrl-Alt-Del attempt, someone sitting at a PC that is acting as a



Both Artisoft and Novell offer a means of expanding from a network with only *LANtastic* or *NetWare Lite* servers to a network mixed with servers using *NetWare* 2.2 and 3.11. Artisoft's method for interoperability comes as a separate package, *LANtastic for NetWare.*

Novell's *NetWare Lite* gains interoperability through its use of Open Data-link Interface (ODI) drivers, which allow you to run multiple protocols on one adapter card. The LAN adapter typically ships with a piece of software customized for the hardware and Novell's link support layer (LSL) software, which comes with all versions of *NetWare.* The IPXODI program, also shipped with *NetWare,* can route packets to and from the *NetWare Lite* redirector, the *NetWare Lite* server software, and the *NetWare* shell that is part of the *NetWare* 2.2 and 3.11 client software. Users simply see each server as a different DOS drive letter. A PC can run as a *NetWare Lite* server and as a client to other *NetWare* servers.

Artisoft's *LANtastic for NetWare* uses a different arrangement of software than *NetWare Lite* but achieves a similar result. With *LANtastic for NetWare,* a user has access to *NetWare* servers and *LANtastic for NetWare* servers but not to *LANtastic* servers. *LANtastic for NetWare* uses Novell's NetBIOS emulator, which interfaces to IPX and is shipped with *NetWare* 2.2 and 3.11. *LANtastic for NetWare* also uses Novell's IPX protocols to handle communications between clients and servers.

server can take the server down by hitting a second three-finger reset or the power switch. The person working at a PC acting as a server also has full access to all files on that PC, even if they are password-protected through the network.

If you want to establish a system of linked LANs with many servers, if you want to use a database server to speed complex queries, or if you want to establish a heavy-duty production network with hundreds of transactions per minute, then look at the higher-priced products such as *LAN Manager, NetWare,* or *VINES*. The higher-priced products also have the ability to integrate Macintoshes and PCs smoothly—a feature these lower-priced products sorely lack.

INTEROPERABILITY AND EXPANSION

When you select a low-cost LAN over one of the more expensive versions of *LAN Manager, NetWare,* or *VINES,* you might give up some capability to interoperate with other network systems or larger corporate internetworking systems.

Products such as Artisoft's *LANtastic for NetWare,* Performance Technology's *POWERLan,* and Novell's *NetWare Lite* give someone sitting at a PC access both to servers running the DOS-based networking software and to servers running the more powerful versions of *NetWare*. But the network administrator must manage separate sets of rights and privileges for each server, and each client PC loses 30K to 50K of RAM to the added network communications software.

While those packages work with other *NetWare* LANs across a bridge or router, only *POWERLan* and *10NET* have the ability to enter into large-scale internetworking systems using TCP/IP routing. *POWERLan* also has options to use Named Pipes, a program-to-program communications technique developed by Microsoft and IBM. Internetworking and Named Pipes capabilities are primarily considerations in government and large institutional networks.

Network-OS Plus, POWERLan, SilverNET, and *10NET* may be able to interoperate with *LAN Manager* servers and with Unix-based server software through the Server Message Block (SMB) protocol. The SMB protocol, developed by Microsoft and IBM, provides the format that the client uses to request information from a server. SMB is functionally similar to NFS and *NetWare*'s NetWare Core Protocol (NCP), but unlike NFS and NCP, SMB implementations vary widely. In addition, many companies have pushed beyond the SMB protocol and spoiled interoperability; demand proof of SMB interoperability before you buy.

INSIDE THE PACKAGING

A networking software package for a DOS-based LAN usually contains one or two disks with a couple of different programs that give a PC the ability to act as a server, as a client, or as both simultaneously. Many companies package the software in a starter kit with two LAN adapters, cabling, and connectors, at a reasonable price tag. For example, a two-user starter kit of *LANtastic* comes with software for 300 users and costs $699.

For PCs acting as clients, you need to load two programs: the redirector and the network communications and driver software. The redirector grabs specific requests for file and print services coming from application programs or from the DOS command line and routes them out to network servers for action. The network communications and driver software takes the requests from the redirec-

EDITORS' CHOICE

- *LANtastic*
- *POWERLan*

Despite a crop of new competitors in the low-cost LAN category, our Editors' Choice awards go to two old-timers: *LANtastic* and *POWERLan*. These products each have a distinct appeal. Another old-timer joins these two as an honorable mention, *10NET*.

We recommend Artisoft's *LANtastic* for networks of PCs that run DOS and that do not have interLAN links. This covers a lot of organizations. But if you have some corporate Unix machines to integrate into the network or if you want to link between LANs using different protocols such as IP, then Performance Technology's *POWERLan* is a better choice. Both Artisoft and Performance Technology should pay attention to our honorable mention, Tiara Computer Systems' *10NET*.

LANtastic is simple and complete. The product is reliable, well supported, well priced, and it is easy to install and use. You should take advantage of Artisoft's combination package of software and its excellent LAN adapters. Artisoft also markets a 10BaseT wiring hub and a standalone communications server that it calls a *connectivity processor,* known as Central Station. In effect, Artisoft provides one-stop shopping for the networking needs of many organizations.

POWERLan is much more flexible and a little more complex than *LANtastic*. *POWERLan* promotes interoperability between computers running different disk operating systems and offers several ways to make connections between LAN segments across bridges or routers. You might not get the one-stop solution from Performance Technology, but *POWERLan* will give you a firm foundation and options for network growth.

10NET, from Tiara Computer Systems, is an old diamond put into a new setting. Over the years, *10NET* has moved from an aggressive pacesetter to an ignored step-child to a well-supported and flexible product. Tiara took the excellent internal structure and flexibility of *10NET* and added a series of menus and utilities that give Version 5.0 useful capabilities. The printing features are vastly improved. *10NET*'s highly structured and standardized protocol stack gives this product room to grow and merge with other networking software products, particularly those running over Unix.

Another product that is worth keeping an eye on is *NetWare Lite,* from Novell. *NetWare Lite* has the power of the Novell name behind it, but the product's limit on the number of users per installation and its lackluster performance on our tests keep it from the top tier of products. With its IPX basis, *NetWare Lite* certainly offers the potential for growth, but that growth has not been realized yet.

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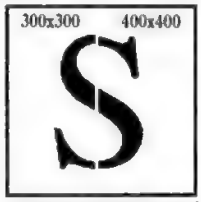

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Manufacturer/Model	Resolution (DPI)	Speed (PPM)	Processor	Page Description Language	List Price
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QMS PS2210	300x300	20	Motorola 68020	Adobe PostScript	$9,995
LaserMaster 400XL	400x400	20	None	Microsoft TrueImage	$9,995
Varityper VT600W	600x600	7	Motorola 68020	Adobe PostScript	$16,995
DEC PrintServer 20	300x300	20	N/A	Adobe PostScript	$25,247
ATI LC6020	300x300	20	Motorola 68020	ATI LaserDrive & PostScript	$15,995

Sources: Dataquest and Dataproducts Corporation, 1991

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SUITABILITY TO TASK

Low-cost LANs are suitable for a wide range of functions, from sharing applications and peripherals to performing administrative duties. How you use these functions depends on your particular organization. Comparing these ratings with the reviews, features table, and benchmark test results will give you a sense of what jobs each product is best designed to handle.

Sharing applications evaluates how easily the LAN allows users to share applications across the network from PC to PC. Products should allow a user to run an application such as *WordPerfect* directly from another user's machine without resorting to workarounds.

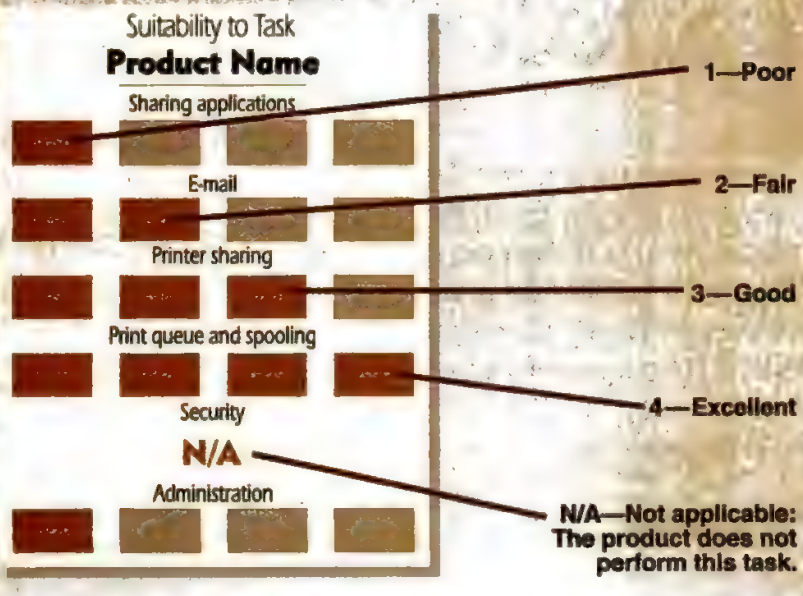
E-mail rates each product's e-mail capacity in terms of successfully sending and receiving messages, creating mailing lists, and allowing the attachment of files to messages.

Printer sharing looks at the LAN's ability to redirect print jobs to a network printer from within an application. Network printing should work transparently and allow users to output files over the network by using the printing features of their applications.

Print queue and spooling evaluates the ability of a product to queue a series of print jobs, enable a supervisor or user to change a job's priority, and print the files successfully in the correct fonts.

Security rates the product's ability to assign unique passwords to users and resources. Products that support supervisor rights should allow you to create a database of user names and rights, view and override passwords, and force users to change passwords periodically.

Administration examines the product's support for administrative tasks and its ease of use in performing them. Tasks involve establishing user names, network resources, log-on scripts, passwords, lists of resources and users, and error logs. The rating takes into account the availability of a menu interface and whether extensive prior knowledge of LANs is required.



tor, packages them for transmission across the network, and moves them on to the LAN adapter. In the packages we reviewed, the redirector and network communications programs together demand between 24K and 112K of memory from a client PC, with an average requirement of about 50K. Smaller programs are usually faster, because they are written in assembly language and their authors can take advantage of undocumented features of DOS to achieve tight integration with the operating system.

The other major program in the package gives a PC the ability to act as a server. Server software accepts requests from the client PCs, handles security, mediates between simultaneous requests for access to the same resources, and provides a way to identify the shared resources through a network name.

Server software usually loads as a TSR, taking up from 32K to 102K of RAM, and sharing the processing time of the CPU. If you give the server software more slices or "ticks" of the processor's time, the server runs faster, but at the possible expense of application programs running in the foreground. But many applications scarcely tap the power of the CPU in 80386- and 80486-based computers; modern desktop PCs have plenty of power to act as servers and run applications at the same time. All of the products in this review provide an option to give all of the computer's power to the server software, though sometimes this is mentioned only in the documentation.

In many cases, companies such as Artisoft, D-Link, Invisible Software, MainLan, Net-Source, and Tiara market their own LAN adapter cards for use with their networking software. Unless you run into an interrupt conflict from a second parallel port or from a hard disk controller in an old IBM PC-XT, you can usually insert the adapter into the PC's expansion bus, connect the cable, load the software, work through one menu, and start networking. If you are fast with a screwdriver, installation of 5 to 10 minutes per PC is the norm with these products.

If you do not use hardware provided by the vendor, however, you must configure the driver software in each PC for the specific LAN adapter in the PC. Some networking software products, such as those from CBIS, D-Link, Performance Technology, and Tiara, will work over any LAN adapter that comes with a com-

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patible implementation of NetBIOS, an interface software specification originally developed by IBM. Hayes and Performance Technology market products that run over any adapters shipped with drivers for the newer Network Device Interface Specification (NDIS) developed by Microsoft and 3Com. These installations can be a little more complex because you might have to gather different pieces of software from different vendors, but they are not difficult.

ROOM TO GROW

The people who write networking software have learned a lot since the early products of the mid-1980s, such as IBM's *PC LAN* and Fox Research's *10NET* (later sold to DCA and then to Tiara). Those products could eat 180K or more of RAM out of a PC acting as a server. They also offered only primitive services for functions such as controlling print jobs, had no interoperability with any other networking software, and worked with a limited choice of LAN adapter cards.

The products we tested in this roundup can take advantage of DOS above 640K to load their component software elements. Several have special interfaces or extra-cost options for Microsoft Windows. The improvement in the control of print jobs is spectacular, particularly in products such as *LANtastic, POWERLan,* and *10NET*. These products give users the ability to direct print jobs to specific networked printers, they offer control features such as the printing of banners for the identification of print jobs, and they notify users when the job is finished, which even some of the "big-buck" products cannot do.

Several products in this review, specifically *LANtastic, MainLan GTi for Windows, NET/30, SilverNET,* and *10NET,* offer excellent integration with Windows, sometimes as an extra-cost option. These options show the network utilities as icons and work through the Windows drivers for print and communications services.

On the whole, low-cost LAN products provide an excellent way to link PCs. You get high value, flexibility, and good performance. With the possible exception of *POWERLan,* these products will not satisfy the needs of companies that want to be at the leading edge of networking technology, but they will easily meet the networking needs of organizations running typical business applications.

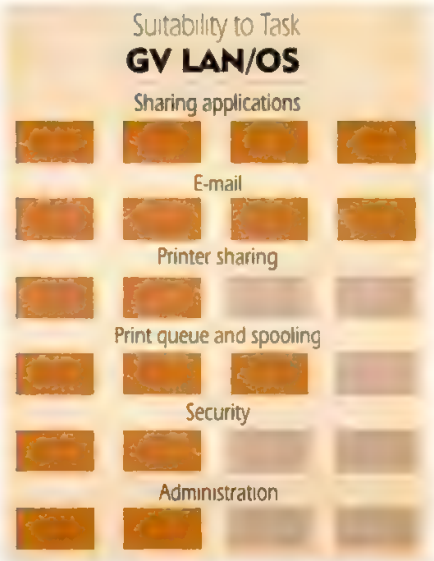
OUR CONTRIBUTORS

Frank J. Derfler, Jr., is workgroup systems editor of *PC Magazine.*
Michael Cohn is a staff editor of *PC Magazine.*
Gary Berline, Steve Rigney, Joe Salemi, and **M. Keith Thompson** are frequent contributors to *PC Magazine.*

GV LAN/OS

BY MICHAEL COHN *GV LAN/OS,* from Grapevine LAN Products, offers a simple and affordable network for small and medium-size offices. The reasonably priced network offers a sophisticated e-mail facility, serial connections for laptops, and acceptable speeds. *GV LAN/OS* runs about $115 per node for the software alone, or $300 for the software together with hardware.

The product does have some drawbacks, though, and its weaknesses are particularly apparent in a corporate environment. First, Grapevine does not include any internetworking support with its product. Second, security in *GV LAN/OS* is limited, although every user has control over their own network defaults, and *GV LAN/OS* provides password security to prevent other users from accessing equipment without permission. Third, while performance was acceptable, *GV LAN/OS* had problems printing from a server during a heavy network load.



With the menus loaded, *GV LAN/OS,* Version 1.4H, uses 122K of memory. Unloading the menus reduces RAM requirements to 87K. We also looked at a prerelease copy of Version 2.0, which should be shipping by the time you read this. Version 2.0 splits the network engine and menu interface into separate programs, using 62K without menus loaded. You can load the engine into high memory with the DOS LOADHIGH command and still have access to network drives. The menu module can then load as a foreground program or as a pop-up. Version 2.0 also includes a utility that uses NetBIOS to generate an error log.

GV LAN/OS's performance was average and improved slightly with Multisoft's *Super PC-Kwik* disk cache loaded. We were unable to send a job to the printer when running our Hard Disk Access Load with Background Printing benchmark test, however, because *GV LAN/OS* gave priority to servicing the continuous disk accesses generated by the disk test. If you have lots of jobs to print, you will need to dedicate a PC to function as the print server, although Grapevine says it intends to fix this problem.

Installation of *GV LAN/OS* is fairly straightforward. The install program copies the necessary files to your hard disk and optionally runs hardware diagnostic tests. You configure your local station through the network program's menu interface, decide which of your drives, directories, and printers you wish to make public or password-protected, and define the ports and drive letters to use for accessing network resources. You can pop up the menus at any time by pressing the Alt key.

SOPHISTICATED E-MAIL

The menus also contain the program's print queue controls and a sophisticated set of e-mail functions. You can create group mailing lists, send files with attached notes, store draft messages on the network for later transmission, and save messages to disk. A built-in notepad with a simple set of editing functions allows you to design forms or questionnaires, circulate them via e-mail, and attach instructions.

The print queue menus let you cancel print jobs, put them on hold, restart them, or move them to the beginning or end of the queue. The menus also display the

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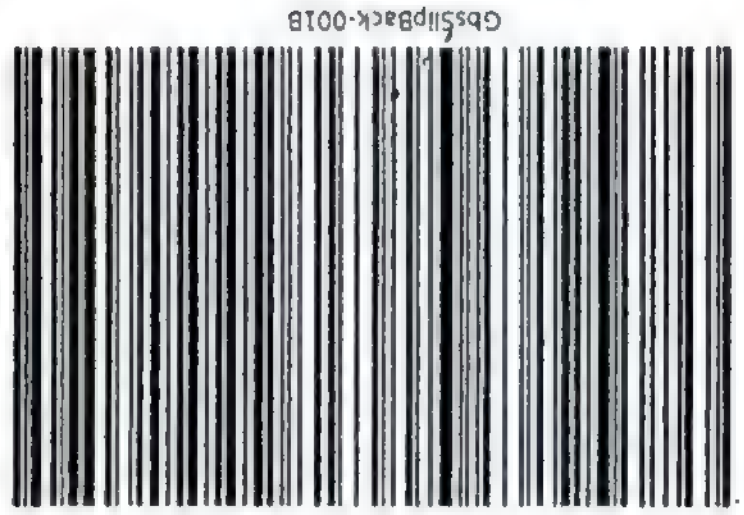

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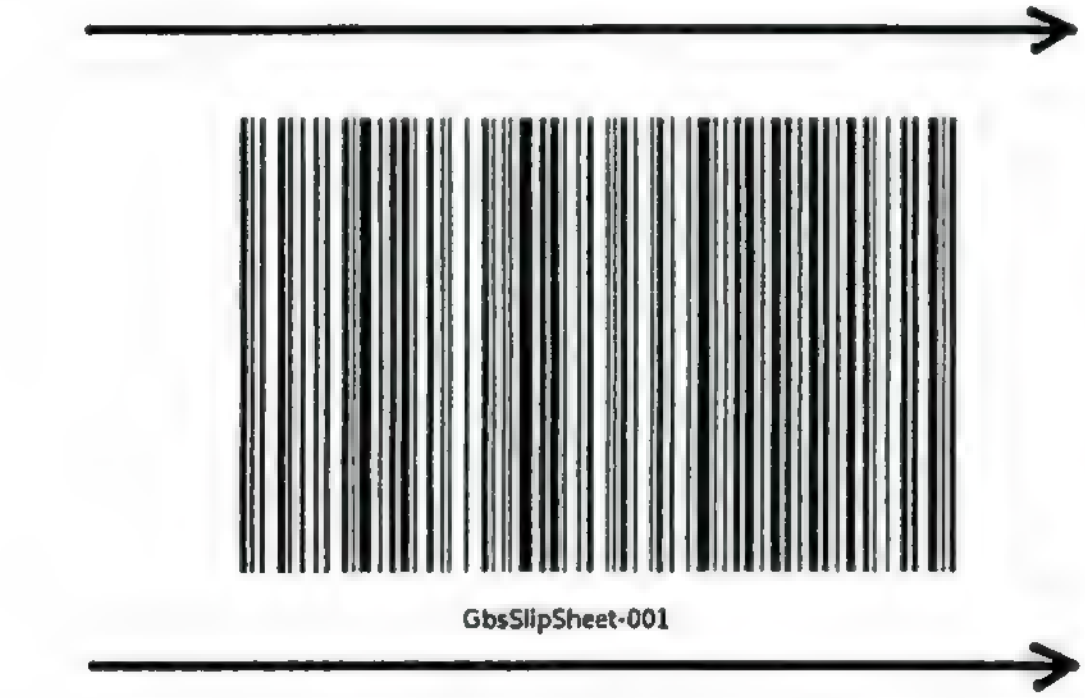

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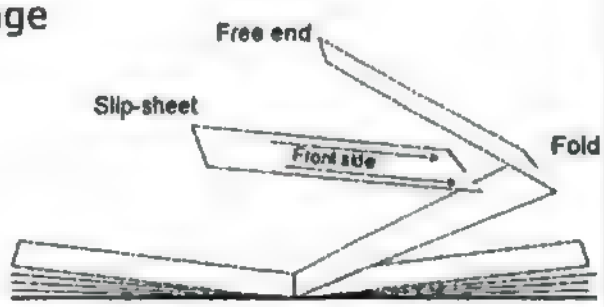
4. Close the page and slip-sheet



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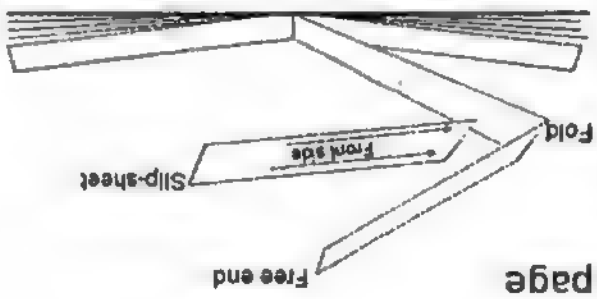

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- Serial mouse
- MS-DOS 5
- MS Windows 3.0

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current status of all print jobs in any queue to which you have access.

In software compatibility tests, we could access and edit *WordPerfect* files over the network, print them with the proper fonts from several stations, and change the print queue. We could also use the Windows Control Panel to change printer settings and run the Windows File Manager over the network, although building the directory tree took a while. *GV LAN/OS* supports Microsoft Windows in Standard and Real modes for most operations, but Grapevine recommends turning off the Windows Print Manager. *GV LAN/OS* also supports Microsoft's MS-DOS CD-ROM Extensions, Version 2.2.

GV LAN/OS is priced at $695 for a seven-user software license and works with Ethernet cards that include SEEQ Technology's 8005 chip set, as well as standard ARCnet cards. Grapevine markets its products mainly through value-added resellers, but the company will sell to end users the $150 8-bit Everex cards and the $185 16-bit cards we tested. The standard software package allows you to connect two machines to your PC's serial ports. Grapevine also markets a serial card that connects up to four PCs or laptops to a *GV LAN/OS* station. In addition to the seven-node license, Grapevine offers a three-node software license for $395 and an unlimited license for $1,095.

Grapevine provides technical support at a toll number from 7:30 A.M. to 6:30 P.M. P.S.T. *GV LAN/OS* is an easy-to-use network that offers minimal security in the form of password protection, but no centralized control. Aside from the rich e-mail functionality, *GV LAN/OS*'s no-frills approach to sharing resources provides adequate performance at a reasonable price.

***GV LAN/OS*, Version 1.4H**
Grapevine LAN Products Inc., 8519 154th Ave. NE, Redmond, WA 98052; 206-869-2707.
List Price: 3-user version, $395; 7-user version, $695; unlimited-user version, $1,095. 8-bit Ethernet card, $150; 16-bit Ethernet card, $185; Serial Plus card, $250.
Requires: 87K RAM, DOS 3.1 or later.
In Short: *GV LAN/OS* is a simple-to-use network operating system with a decent price and fair performance. It also has an e-mail function with plenty of features and it can connect laptops through a station's serial port.

CIRCLE 508 ON READER SERVICE CARD

LANsmart

BY GARY BERLINE If internetworking is key, check out D-Link Systems' *LANsmart*. Reasonably priced at about $320 per node for a six-station network, *LANsmart* is one of the few DOS-based LANs to run multiple protocol stacks. But with the extra connectivity comes sacrifices. *LANsmart* offers mediocre performance and security.

The product focuses most heavily on connecting to different computing environments. With *LANsmart*, you have simultaneous access to mainframes, Unix systems, and *LANsmart* servers. An especially useful command, SUBMIT, starts processes on remote stations, which lets you run files containing batch-like commands on a networked drive. Extra-cost options include a range of products, such as Ethernet bridges and hubs.

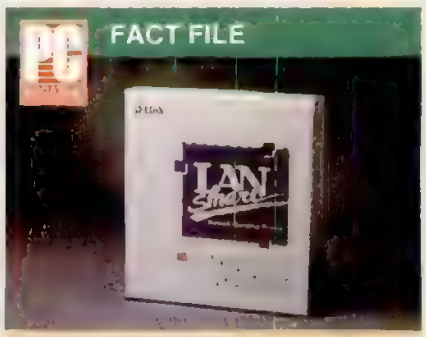
Compared with its competitors, *LANsmart* suffered on PC Magazine Labs' Hard Disk Access Load and Directory Access Load benchmark tests. With no load on the network, *LANsmart* scored in the lowest third of the tested products at 0.62 megabits per second (Mbps); performance dropped off steeply with increasing loads. During our testing, *LANsmart*'s printing capabilities demonstrated one drawback: The first print job often bypassed the queue, making queue control impossible. Subsequent jobs appeared in the queue, but the first print job always went straight to the printer.

As a server, the program uses a 105K chunk of conventional RAM. When loaded into high memory, however, *LANsmart* consumes between 0 bytes and 45K of conventional RAM. On workstations, *LANsmart* sneaks off with only 45K, 2K, or no lower RAM. D-Link's disk cache stores to conventional, extended, or expanded memory. The disk cache occupies 15K in the DOS region but can load entirely into upper memory blocks.

RESOURCE SECURITY

LANsmart's security sags a bit. Aside from DOS-like read, read/write, and read/write/create security, *LANsmart*'s one significant security level is for resources. Passwords are given only to resources, and only a limited selection of access rights is available.

The program's auto-reconnect feature offers enhanced convenience in case a server fails; it automatically reestablishes connections when the server comes back



***LANsmart*, Version 3.20**
D-Link Systems Inc., 5 Musick, Irvine, CA 92718; 714-455-1688.
List Price: Starter kit (with two 16-bit 10BaseT cards, unlimited-user software, cabling, and test device), $865. Unlimited-user software, $395; card, $245. 16-bit combination 10BaseT adapter and 4-port hub, $495; 16-bit 4-port 10BaseT hub extender, $200.
Requires: Any D-Link interface card. DOS 3.1 or later. Server: 640K RAM recommended. Client: 512K RAM recommended. Peer-to-peer operation: 2K RAM in workstation, 35K RAM in print server, 40K RAM in file/print server.
In Short: Easy installation, simple operation, low price, and the ability to access multiple platforms simultaneously make *LANsmart* worthy of consideration. But passing attention to security and poor performance that bogs down under load limit the product to small, lightly loaded LANs.

CIRCLE 509 ON READER SERVICE CARD

up. *LANsmart* also provides a virus detector and clock synchronization, which lets you match the DOS date and time on your node with another machine's. A logging utility records each time a file opens and closes and which stations request the files. No UPS monitoring is currently available.

LANsmart users can issue commands at the command line or access the program's clear menuing system. Simple messaging and a good, four-way chat facility come with the package. But e-mail currently sells as a $195 add-on.

LANsmart also does a decent job running Microsoft Windows 3.0 programs in 386 Enhanced mode, but it offers no specific integration with Windows, as MainLan's *MainLan GTi for Windows* does. It requires no special driver, only the LOGON switch /WIN:ON. The product also supports Microsoft's MS-DOS CD-ROM Extensions 2.2.

D-Link bundles more drivers with its boards than you can shake a NIC at. Most come with the package, but some are available via a free bulletin board. *LANsmart* also comes with a NetBIOS for working with other NetBIOS-compatible systems. Object code to generate IPX allows you to use D-Link's hardware on a *NetWare* network. Any system supplying a standard NetBIOS or written for the NE1000/2000 cards formerly marketed by Novell can use D-Link adapters.

LANsmart's printing system provides a customizable separator page. Print management functions let you shift jobs to other queues and delete, hold, release, or reorder them. Anyone at the server can manipulate all jobs, but from a workstation, you can control only those you send.

10BASET CONFIGURATION

D-Link markets *LANsmart* software for $395 per network. Our $865 starter kit included two 16-bit 10BaseT cards (NE2000-compatible), unlimited-user software, two 10-foot twisted-pair cables, and a testing device. One 16-bit adapter costs $245; the cards ship with diagnostics but no cable, and they use the starter kit's software. With cabling, the price becomes about $320 per node.

Our setup replaced one of the cards with a $495 combination 10BaseT adapter/four-port hub card and also used one $200 four-connection extension board, bringing the total for six stations to $2,295, or about $383 per node.

D-Link Systems' manuals offer clear descriptions and the system works smoothly. If you need help, D-Link Systems provides unlimited free support via a toll number from 7:00 A.M. to 5:00 P.M. weekdays P.S.T., and the company runs a bulletin board.

LANsmart needs a boost in performance and security, but it still represents a good value for lightly loaded networks (and purses) that need extensive connectivity options.

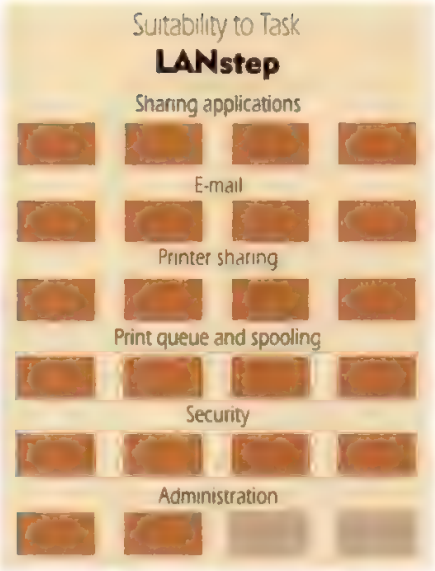
LANstep

BY STEVE RIGNEY Whether or not Hayes's *LANstep* is your solution is a matter of perspective. If security and electronic mail at $119 per node are important to you, *LANstep* cannot be beat. But if you expect to get strong Microsoft Windows support, solid performance, low memory consumption, and internetworking support, *LANstep* will not be the right choice to meet your needs.

Hayes Microcomputer Products acquired the *LANstep* program from Waterloo Microsystems, who originally called the software *Waterloo Port*. *LANstep* produced low scores on the PC Magazine Labs benchmark tests; the product showed slightly better throughput during the Directory Access Load tests than when it was running our Hard Disk Access Load tests.

Hayes attributes *LANstep*'s performance to the fact that the server software does not cache data written to the hard drive but instead stops processing and writes the data to disk. The company claims that this adds to *LANstep*'s reliability, because the information is not vulnerable to power failures.

One of *LANstep*'s major problems was RAM usage. By consuming too much conventional RAM, *LANstep* can easily interfere with your ability to run certain programs on the client. Both the *LANstep* file server and workstations require at least 1.5MB of extended memory just to install the multitasking operating system. As the number of workstations increases, more extended memory is needed in the server to support them. DOS workstations are also susceptible to memory crunch. The network software takes up approximately 112K of conventional memory on the client PC.



OPERATING SYSTEM SECURITY

Security is one area where *LANstep*'s use of a proprietary operating system becomes an advantage. On a DOS-based server, it is difficult to prevent someone from booting from a floppy disk and using DOS to gain access to any information contained in the files on the PC. *LANstep* servers and workstations are "DOS-proof" and thus provide the security usually found only by locking the keyboard on a DOS-based machine.

LANstep presents a unique graphical user interface (GUI) as a front end to the network and all applications. Icons depict rooms and offices containing programs,

***LANstep*, Version 1.0B**
Hayes Microcomputer Products Inc., P.O. Box 10503, Atlanta, GA 30348, 404-840-9200
List Price: 5-user software-only starter kit, $595; 2-user starter kit (with hardware), $795. Additional 5-user software, $395; additional 20-user software, $595.
Requires: Server: 640K RAM, 20MB hard disk, 1.5MB extended memory. Client: 25K to 112K RAM. Peer-to-peer operation: 25K RAM, 1MB extended memory.
In Short: *LANstep* makes big hardware demands and does not work smoothly with Windows. But it is reasonably priced, shares resources well, and has a good electronic mail package.

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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

TIARA

SUMMARY OF FEATURES

Products listed in alphabetical order

PC — Editors' Choice
■—Yes ❑—No

	GV LAN/OS	LANsmart	LANstep	LANtastic	MainLan GTi for Windows
List price (tested configuration)	$1,325.00	$1,845.00	$2,240.00	$1,895.00	$1,399.75
Includes	Software and hardware for 7 users	Software and hardware for 6 users	Software for 6 users	Software and hardware for 6 users	Software and hardware for 6 users
GENERAL FEATURES					
Hardware available separately	■	■	❑	■	■
Software available separately	■	■	■	■	■
Maximum number of users served	50	254	128	300	64
Hardware manufacturer	Varies	D-Link Systems	Varies	Artisoft	United Network
Drivers included with adapters:					
NDIS (Network Device Interface Specification)	■	❑	■	❑	❑
NetBIOS	■	■	❑	■	■
NetWare 2.x (IPX)	■	■	❑	❑	■
ODI (Open Data-link Interface)	■	■	❑	❑	■
ADAPTERS AVAILABLE FROM VENDOR					
On-board memory	64K	16K	16K	16K	64K
Other Ethernet cards available	ISA	ISA, EISA, MCA	ISA, EISA, MCA	MCA	ISA, MCA
8-bit	■	■	■	■	■
16-bit	❑	■	■	■	■
32-bit	❑	■	❑	❑	❑
Token-Ring cards available	None	ISA, MCA	ISA, EISA, MCA	None	None
8-bit	N/A	■	■	N/A	N/A
16-bit	N/A	■	■	N/A	N/A
32-bit	N/A	❑	❑	N/A	N/A
ARCNET cards available	ISA, EISA, MCA	ISA, MCA	ISA	None	None
8-bit	■	■	■	N/A	N/A
16-bit	■	■	■	N/A	N/A
OPERATING SYSTEMS SUPPORTED					
DOS	■	■	■	■	■
Microsoft Windows	❑	■	■	■	❑
OS/2	❑	❑	❑	❑	❑
MEMORY					
Server:					
Required RAM	87K	105K	640K	58K	80K
Loads into extended memory	■	■	■	■	❑
Loads into expanded memory	❑	■	❑	■	❑
Unloads without rebooting	■	■	❑	■	■
Client:					
Required RAM	87K	45K	25K–112K	24K	35K
Loads into extended memory	■	■	■	■	❑
Loads into expanded memory	❑	❑	❑	■	❑
Unloads without rebooting	■	■	■	■	■
.SYS drivers in CONFIG.SYS	❑	❑	■	❑	❑
Software includes disk cache	❑	■	■	■	■
Built-in memory manager	❑	■	❑	❑	❑
Memory managers supported:					
NetRoom	■	■	■	■	■
QEMM	■	■	■	■	■
Loads multiple stacks in workstation	■	■	❑	■	■
PRINTING					
Displays queue at workstation	■	■	■	■	■
User and administrator can delete jobs	■	■	■	■	■
User and administrator are alerted to empty paper trays	■	❑	❑	❑	❑
Offers customizable separator pages	■	■	■	■	■

N/A—Not applicable: The product does not have this feature.

NET/30	NetWare Lite	Network-OS Plus	POWERLan	SilverNET	10NET
$2,094.00	$495 00	$1,988.00	$795.00	$2,095.00	$2,097 00
Software and hardware for 6 users	Software for 6 users	Software for 80 users	Software for unlimited users	Software and hardware for 6 users	Software and hardware for 6 users
☐	■	☐	■	■	■
■	■	■	■	■	■
99	25	254	Unlimited	254	Unlimited
Invisible Software	Eagle Technologies	Varies	Exos	Varies	Tiara Computer Systems
☐	☐	☐	☐	☐	■
■	■	■	■	■	☐
☐	■	☐	☐	☐	■
☐	■	☐	☐	☐	■
16K–64K	16K	16K	None	16K	64K
ISA, MCA	MCA	ISA, EISA, MCA	ISA, EISA, MCA	EISA	ISA, EISA, MCA
■	☐	■	■	■	■
■	■	■	■	■	■
☐	☐	☐	■	☐	☐
None	ISA, EISA,MCA	ISA, EISA, MCA	ISA, EISA, MCA	ISA	None
N/A	■	■	■	■	N/A
N/A	■	■	■	■	N/A
N/A	■	☐	■	☐	N/A
None	None	None	ISA, EISA, MCA	ISA	ISA, EISA, MCA
N/A	N/A	N/A	■	■	■
N/A	N/A	N/A	■	■	■
■	■	■	■	■	■
■	■	■	☐	■	■
☐	☐	☐	■	☐	☐
85K	49K	56K	66 5K	32K	69K
■	☐	■	■	■	☐
■	☐	■	☐	■	☐
☐	■	■	■	■	☐
60K	27.5K	31K	43K	16K	32K
■	☐	■	■	■	☐
■	☐	■	☐	■	■
☐	■	■	■	■	☐
■	☐	☐	☐	☐	■
■	■	■	■	■	■
■	☐	☐	☐	☐	■
☐	■	■	■	■	■
■	■	■	■	■	■
☐	■	☐	■	☐	■
■	■	■	■	■	■
■	■	■	■	■	■
☐	☐	☐	■	☐	■
■	■	■	■	■	☐

CONTINUES

SUMMARY OF FEATURES

Products listed in alphabetical order

PC — Editors' Choice
■—Yes ❑—No

	GV LAN/OS	LANsmart	LANstep	LANtastic	MainLan GTi for Windows
PERIPHERALS					
Supports CD-ROM	■	■	■	■	❑
Supports remote-boot ROM	❑	■	■	■	❑
Supports UPS	❑	❑	❑	■	❑
NETWORK MANAGEMENT					
Interfaces with IPX/SPX	❑	■	❑	■	❑
Detects disconnected adapter	■	■ (at log-on only)	■	■	❑
Warns of bad frames or packets	■	❑	■	❑	❑
USAGE INFORMATION					
Keeps error log	■	❑	■	■	❑
Tracks resource usage	❑	■	❑	■	■
Displays active users	■	■	■	■	■
SECURITY					
Hides files/directories	❑/■	❑/❑	■/■	■/■	❑/❑
Creates security groups	❑	❑	❑	■	❑
Sets account expiration date	❑	❑	❑	■	❑
Sets time restrictions	❑	❑	❑	■	❑
File password protection	■	■	❑	■	■
Other file protection	❑	❑	■	■	❑
User rights:					
Execute	❑	❑	❑	■	■
List	❑	❑	❑	■	❑
Read	■	■	❑	■	■
Write	■	■	❑	■	■
Create	■	■	❑	■	■
Warns of illegal entry attempts	❑	❑	❑	■	❑
SOFTWARE FEATURES					
Offers menus and DOS command line	■	■	■	■	■
Displays available network resources	■	■	■	■	❑
Messaging	■	■	■	■	❑
Chat	❑	■	❑	■	❑
E-mail	■	■	❑	■	■

utilities, and network resources. Each icon represents a network service; "doors" move the user into subwindows, or "rooms," depicted by additional icons. A user's personalized room is called an "office." You can easily move the icons about the screen, and new icons are simple to create for new network resources.

You can use a mouse or other pointing device with *LANstep*, but Windows users will need new training in mouse operation. You select a room with the left mouse button and click the right mouse button to enter and perform any desired tasks. Once you get the hang of it, the interface is easy to use.

The multitasking environment on *LANstep* servers and workstations allows users to run DOS commands and programs within a *LANstep* door. Unfortunately, this DOS door cannot run programs in protected mode, so Windows users will either have to live in Real mode under Windows 3.0 or else change machines.

LANstep includes file- and printer-sharing capabilities. It can also access CD-ROM drives, but CD-ROM application support is limited. DOS and Windows applications can easily run across the network if you do not have RAM limitations.

LANSTEP INSTALLATION

If you take the time to understand the concepts behind *LANstep*, the installation procedure is fairly easy. A *LANstep* network includes three categories of nodes: DOS client PCs, *LANstep* workstations, and *LANstep* servers. DOS clients boot from their own drives and can use the resources of *LANstep* servers, but they cannot share their drives and printers with any other nodes. *LANstep* workstations receive their boot-up information from a *LANstep* server. The workstations can share their hard disks with each other and can access the servers' resources.

The *LANstep* workstation and server do not run DOS; instead they use a proprietary multitasking operating system. The installation process requires formatting the hard disks on the *LANstep* workstations and server. This can take several hours depending on the size of the drive you are using.

You must have a "key" disk to install the *LANstep* nodes and servers. This key disk can be copied for backup but you cannot make multiple copies from a single disk, so you need to make sure you have the right-size disk for each machine on your network.

LANstep workstations either use boot ROMs or boot locally and then connect automatically to the server. DOS workstations do not have to be reformatted

NET/30	NetWare Lite	Network-OS Plus	POWERLan	SilverNET	10NET
■	⌋	⌋	■	■	■
■	⌋	■	■	⌋	■
⌋	⌋	⌋	■	⌋	⌋
⌋	■	⌋	⌋	⌋	■
⌋	⌋	⌋	⌋	■	⌋
⌋	■	⌋	■	■	■
■	⌋	⌋	■	■	■
■	■	⌋	■	■	■
■/■	⌋/⌋	■ ■	⌋/⌋	⌋/■	■/■
■	⌋	■	■	⌋	■
⌋	■	■	■	⌋	■
⌋	■	⌋	■	⌋	■
■	⌋	■	■	■	■
■	⌋	■	■	■	■
■	⌋	■	⌋	■	■
■	■	■	■	■	■
■	■	■	■	■	■
■	■	■	■	■	■
■	■	■	■	■	■
■	⌋	⌋	■	⌋	■
■	■	■	■	■	■
■	■	■	■	⌋	■
■	■	■	■	⌋	■
■	⌋	⌋	■	⌋	■ (Da Vinci eMail)

ENDS

with the *LANstep* operating system; they simply load the NDIS drivers and log on to the *LANstep* file server.

LANstep Mail is one of the most full-featured e-mail programs bundled with a network operating system. Through LANstep Mail, you can create distribution lists, attach files or whole directories, and send registered mail. LANstep Mail also contains a built-in editor. *LANstep Mail Gateway* retails as a $395 option and allows the exchange of mail between remote *LANstep* networks.

You cannot complain about *LANstep*'s price. A basic package of *LANstep*, Version 1.0B, retails for $595 and includes software for five simultaneous network users and the LANstep Mail program. Other configurations are available in the form of *LANstep* 5-Step and 20-Step Expander Kits, which cost $395 and $595, respectively. The *LANstep* network can grow to support a maximum of 128 simultaneous users and 255 workstations per network.

The *LANstep* Starter Kit is also available to users at a price of $795. The package contains a five-user version of the network operating system software, two Hayes EtherMate 8 network adapters, 12 feet of thinnet, and connectors. *LANstep* uses the NDIS software and is compatible with any of the many network adapter cards that support this specification.

Hayes needs to address the heavy memory requirements and the problem of running Microsoft Windows on *LANstep* workstations. *LANstep* is an easily expandable but different LAN offering. It provides some functionality and power for people who do not need *NetWare* yet want the ability to share resources and files.

LANtastic

BY STEVE RIGNEY When it comes to DOS-based LANs, Artisoft's *LANtastic* is a clear leader. An Editors' Choice winner for the past three years, *LANtastic*, Version 4.10, offers a slew of improvements to the command line, menuing, and ease-of-use of the older versions, including more flexible log-on capabilities and enhanced print-queue control. Not surprisingly, the efficient *LANtastic* consumes only 24K to 58K of RAM and placed second in number of requests per second on our tests. The software by itself is a bargain at $99 per node.

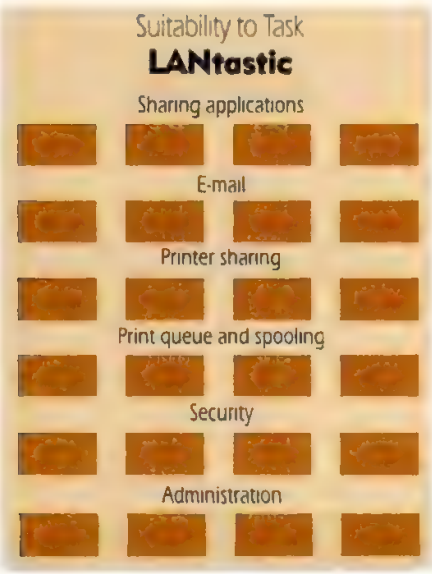
A key factor behind *LANtastic*'s performance is its faster version of NetBIOS. *LANtastic* also uses a feature called *resource caching* to speed file lookups and

the process of opening files. With resource caching, a template of users' access rights is held in RAM, not on the slower hard disk.

Unfortunately, *LANtastic* by itself contains no built-in internetworking hooks for connecting to *NetWare* and other network operating systems. But Artisoft markets *LANtastic for NetWare,* a separate version of *LANtastic* that lets you add peer-to-peer connectivity to a *NetWare* server, along with most of the features of *LANtastic* (see the sidebar "Moving Up to NetWare"). *LANtastic* normally runs Artisoft's own version of NetBIOS; *LANtastic for NetWare* runs Novell's NetBIOS over Novell's IPX protocol. *LANtastic for NetWare* does not give you routing, bridging, or Named Pipes capability in itself. You need to have *LANtastic for NetWare* running in each machine that is going to access both network systems.

LANtastic for NetWare offers several advantages over *NetWare Lite,* the only other offering in this review that provides interoperability with *NetWare 2.x* and *NetWare 3.x* networks. First, you get most of the extra functionality available to users of standard *LANtastic*. Second, you can connect 300 users for $499 with *LANtastic for NetWare,* as opposed to the flat $99 per node price that you pay for *NetWare Lite*.

Some third-party vendors, such as FTP Software and The Wollongong Group, also market add-on products that you can use for accessing TCP/IP networks from DOS-based LANs such as *LANtastic,* but these other products are not specific to *LANtastic*.



EFFECTS OF CACHING

The *LANtastic* package includes LANcache, a disk-caching program that you can configure to use extended, expanded, or conventional memory. LANcache is one of the fastest disk-caching programs for networks available today. Although not as fast as *POWERLan*'s cache, LANcache is built into the system, which gives it an advantage over third-party add-ons. The communications software is also tightly integrated with the adapter cards.

LANtastic requires only 24K of RAM for a client PC, and 58K for the server. You can load the *LANtastic* modules into the upper-memory area using MS-DOS 5.0's EMM386 memory manager or a third-party product such as *QEMM* or *Netroom. LANtastic* 4.10 gives users the ability to configure the server's program size in RAM, allowing better performance from the LAN.

IMPROVED INTERFACE CHOICES

The most impressive new additions in *LANtastic* 4.10 are the improvements and features added to the LAN's printing capabilities. The print-job display now shows the status of each print job, the estimated time when it will start printing, and the estimated time remaining until completion.

You can easily execute the *LANtastic* utilities and programs from the DOS command line, through a 7K TSR called LANPUP, or from one of two menus, NET and NET_MGR. Artisoft also offers a Windows version of NET and NET_MGR in a package called *LANtastic for Windows* that sells separately for $299 per network (reviewed in "First Looks," page 48, January 14, 1992). This front-end for *LANtastic* lets you link to network resources using icons and a Windows pointing device.

The *LANtastic* NET menu runs under DOS and is an easy-to-use network interface program. It lets you log onto servers, redirect drive letters and ports, display and control print queue status, send electronic messages and mail, and display server activity. You can also execute all of these actions from the DOS command line.

As with the NET commands, *LANtastic* eliminates much of the time spent creating personalized user accounts on the LAN. Instead, you can execute NET_MGR commands right from the DOS command line. These new programs allow you to create, copy, edit, and delete user accounts without the NET_MGR menu interface.

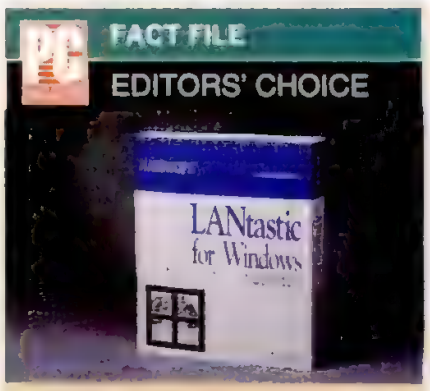
A new feature of *LANtastic* called AutoLogin connects users or supervisors to a server's resources without making them specify a user name or password. A default user name and password are stored at the workstation in encrypted form. When the user requests redirection to a network resource, the system provides the default user name and password automatically.

Another helpful feature, Wildcard Login, lets you log onto any server and resource that you have rights to without specifying the server name. This is a step toward establishing a universal naming service where resources are networkwide rather than associated with a particular server.

A PLACE AT THE TOP

In a market centered around features and functionality, *LANtastic* has a place at the top. Its standard features range from CD-ROM sharing with Microsoft's MS-DOS CD-ROM Extensions 2.2 to a full-featured e-mail program that rivals some more expensive network operating systems requiring dedicated servers.

LANtastic's Delayed Record Locking allows a server to hold onto a user request for a record that is already locked by another user accessing it. The operating



***LANtastic*, Version 4.10**
Artisoft Inc., 691 E. River Rd., Tuscon, AZ 85704; 800-846-9726, 602-293-6363.
List Price: 2-user starter kit (with two 16-bit NE2000-compatible adapters, cable, 300-user software), $699.
Requires: Server and client: 256K RAM.
In Short: Version 4.10 of *LANtastic* is an improvement on an award-winning product. The addition of standard features such as AutoLogin and Wildcard Login and improved print queue maintenance capabilities make *LANtastic* one of the most full-featured low-cost LANs on the market.

CIRCLE 511 ON READER SERVICE CARD

Last time, it was the experts' choice. This time, it's the easy choice.

The new IRMA WorkStation for Windows 1.1

From the very beginning this 3270 emulation software was the No. 1 choice of experts like the editors of *PC Magazine*. It brought a host of sophisticated features into the wonderful world of Windows™ connectivity. But it was only the start.

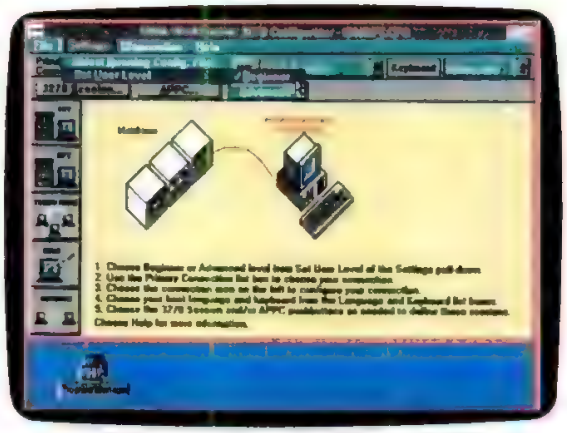
PC MAGAZINE EDITORS' CHOICE

February 26, 1991 IRMA WorkStation for Windows, Ver. 1.0.

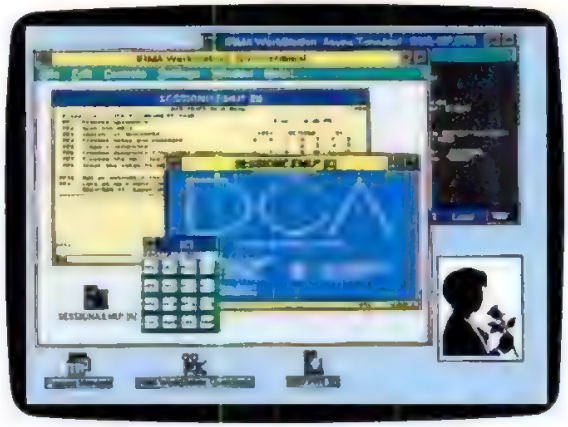
Now, we've made IRMA™ WorkStation for Windows so incredibly simple to install and operate, that it's the easy choice for anyone!

The new 1.1 version virtually installs itself. Instead of asking endless questions during "SET-UP", it senses your communications adapter and then pre-configures the software accordingly. Say you have an IRMA 3® Convertible coax card. With the "Intelligent User Assist" program it will automatically pre-configure the CUT and DFT connections. If you have an IRMAtrac™ token-ring adapter, it will pre-configure a token-ring connection.

Once installed, our new software is easier to operate, too. Using the familiar Windows Multiple Document Interface (MDI), you get the easy efficiency of managing multiple sessions with a single menu bar.



Installation couldn't be easier! The new Intelligent User Assist automatically senses the communications adapter in your PC. A Configurator Screen shows your PC and its connection to the mainframe.



Multiple Document Interface (MDI) lets you manage multiple communications sessions with a single menu bar in the main 3270 terminal emulation window.

Integrating mainframe data into your other Windows applications is no problem either. You'll find a breadth of application integration tools like macros, QuickScript™ with DDE, HLLAPI and APPC.

Just as important, with this IRMA software package, you can get into "Windows" connectivity no matter how you're connected. There's CUT, DFT, SDLC, token-ring and asynchronous connections. And what's more, IRMA WorkStation for Windows can now even act as client software for DCA®'s IRMALAN™/*EP* 3270 NetBIOS gateway. No one offers as many connectivity options!

It's even easy to try!

Trying out the new IRMA WorkStation for Windows 1.1 is as easy as asking for a copy of our **FREE DEMO DISK.** Better yet, you can trade up to IRMA WorkStation for Windows from any other 3270 connectivity software (that's right, ours or anyone else's) for only $95. All you do is call.

Just call 1-800-348-DCA-1, ext. 89A.*

The new IRMA WorkStation for Windows 1.1. Last time, it was impressive. This time, it's irresistible.

IRMA WorkStation for Windows

Another Communications Solution From

DCA.

** Or call (404) 475-8380 if outside the U.S. Limited time offer.* *© 1992 Digital Communications Associates, Inc. All rights reserved. DCA and IRMA 3 are registered trademarks and IRMA, IRMAtrac, QuickScript and IRMALAN are trademarks of Digital Communications Associates, Inc. All other brand and product names are trademarks or registered trademarks of their respective owners. Reprinted from PC Magazine, February 26, 1991.*

CIRCLE 389 ON READER SERVICE CARD

system completes the request once the record is unlocked. Without this feature, the user request would be denied and the attempt would have to continue until completed, thus degrading server response time.

INSTALLATION IN MINUTES

Installing *LANtastic* on both the client and the host PCs takes just minutes. You can elect to redirect drives and ports, share resources, and set up all log-on and connection commands. The program stores this information in a batch file that you can edit at any time.

LANtastic is priced at $699 for an Ethernet Starter Kit that includes two AE-2 network adapter cards, 25 feet of thin coaxial cable, and software for 300 nodes. The $899 10BaseT Startup Kit includes the same software, AE-1T cards, and PureHub concentrator. The AE-1T costs $199 if purchased separately; the PureHub sells for $399.

The standard version of *LANtastic* only runs over Artisoft cards. But the company offers an adapter-independent version for $99 per node that contains drivers for most important adapters with NetBIOS drivers, such as those from 3Com and Standard Microsystems Corp.

Artisoft's AE-2 ($299) adapter clones the operation of the NE-2000 and can run in any network that supports Novell adapters. Artisoft also sells the AE-3 ($349) network adapter, which includes connectors for thick and thin Ethernet and 10BaseT unshielded twisted-pair wiring.

Artisoft offers a free technical support line from 7:00 A.M. to 5:00 P.M. M.S.T., a BBS, and a forum on CompuServe. Its operating system is fast, flexible, and easy to install and manage. *LANtastic* 4.1 offers so many helpful features, it is hard to discuss them all in one review.

MainLan GTi for Windows

BY JOE SALEMI For easy network access, MainLan's *MainLan GTi for Windows* offers an attractive solution. Its tight integration into Microsoft Windows makes *MainLan* a snap to use and its low cost of $233 per node makes it one of the least expensive networks around. A DOS interface is also offered.

Unfortunately, choosing *MainLan* requires some sacrifices. Version 3.31E offers neither better performance nor improved security capabilities, and its memory requirements are higher than those of its predecessor, *MainLan Ethernet*, Version 3.22 (reviewed in "DOS-Based LANs Grow Up," June 25, 1991). In addition, *MainLan* 3.31E cannot automatically restore server connections, unlike some other products in this review. But *MainLan* remains easy to install, configure, and use; it offers an acceptable choice as long as security and speed are not significant factors.

You can make a system a nondedicated server, print server/workstation, or workstation only, and make local printers and drives available to the network. In our test configuration, the server software took up 80K RAM and the workstation 35K RAM, about midrange compared with other products. Making a workstation a print server takes another 5K; but *MainLan* will use LIM EMS if present, which reduces the required workstation RAM to 19K. You can load all the software into high memory with the DOS 5.0 LOADHIGH command on 80386 systems. *MainLan* does not offer CD-ROM support.

SLOW BUT STEADY

MainLan proved dependable but placed in the middle of the pack in terms of performance: Throughput on the Hard Disk Access tests was 0.33 megabits per second (Mbps) for three workstations and 0.19 Mbps for five workstations. As demonstrated during the Hard Disk Access Load with Background Printing test, *MainLan* assigns printing a low priority. A background printing job causes little impact on disk performance, but printing slows to a crawl.

A utility included with the package adjusts the print spooler's priority level, but be warned: Setting too high a priority to the print job diminishes the server's disk performance. You will need to experiment to find the proper balance between disk access and printing speed for your situation.

MainLan provides minimal security features and does not offer user or group passwords. The only security is control over which directories on the server's disk can be shared and to what access level (read, write, and create, or combinations of the three). Although you can send print jobs from several stations at once, the program lacks a print queue manager.

We discovered one other drawback: *MainLan* will not automatically restore a workstation's connections to the server if the server goes down and comes back up. This caused a problem with some applications that were loaded off the server, such as *WordPerfect* 5.1; the system requires a reboot to recover, and unsaved data can be lost.

EASY INSTALLATION

Installing the network is easy with the menu-driven setup utility. You also set up the included e-mail application at this point; it loads automatically when the workstation software is loaded. The e-mail utility allows simple user-to-user messages, but not the creation of mailing-list groups. The Windows interface comes on a separate disk, and its setup utility automatically adds the appropriate programs and libraries to make them available the next time Windows is run.

Although the setup utility adds the necessary lines to the AUTOEXEC.BAT file to run the LAN, you must load any NetBIOS drivers specific to the network card before the *MainLan* software. You also must install the included copy of Multisoft's *Super PC-Kwik* disk cache software on the server.

A two-node starter kit retails for $599.95 and includes the software (which supports up to 64 users), 16-bit 10-Mbps Ethernet cards, T-connectors, and thin coaxial cable and terminators. Also included is a copy of *Super PC-Kwik* for the server. Additional cards cost $199.95 each, bringing the total cost of our six-node test

There was a time when we all worked QMS-PS 1700 *individually. We each had a computer and we each had a printer. Today, many of us work in groups. We choose our computers for their ability to perform well within networks. Shouldn't the same criterion now apply to our printers?*

How to Spot the True Network Printer Among a Host of Imitators.

1-800-523-2696 EXT 314

Unlike most printers that merely claim to be appropriate for network applications, the QMS-PS® 1700 was conceived and built to be the most efficient printer there is in a network environment. In terms of cost, as well as performance.

Proprietary software that resides within a 25 MHz RISC controller is what sets this printer apart from all others.

It handles PostScript® documents up to six times faster than the more common 68020 microprocessor. And it's the heart of an architecture you'll find in printers that come from QMS and only QMS. We call it Crown.

Consider whether its benefits would help your group work even more efficiently.

The QMS-PS 1700 recognizes incoming data and selects the right printer language without troublesome software reconfigurations.

The QMS-PS 1700 connects to Ethernet® networks configured as DECnet®, TCP/IP, NetWare®, or EtherTalk™ protocols or to Token Ring configured to support the NetWare protocol. And it can be shared between multiple computers with different operating systems.

Its input buffers spool jobs so that host applications aren't hung up waiting for files to print.

The input capacity of the QMS-PS 1700 is 1,000 sheets. Output is 500. And there's an optional duplexer for two-sided work.

What's more, if a job is interrupted for any reason, this printer has the intelligence to reprint any needed pages and then continue.

Its context switching capability preserves "states," such as fonts and macros, when switching between emulations so you don't waste time downloading them each time.

Font or emulation storage can be expanded with optional internal and external SCSI hard drives.

So the QMS-PS 1700 is much more than a laser printer. In fact, it's exactly what most work groups need but haven't been able to find. Until now. The QMS-PS 1700 is The Network Printer.

QMS

The Rom card gives control over the

the LAN administrator printer's settings.

	QMS-PS 1700	HP IIIS
Both 300 and 600 DPI resolution	✔	
Concurrent interfacing	✔	
Spooling	✔	
Context switching	✔	
Security system	✔	

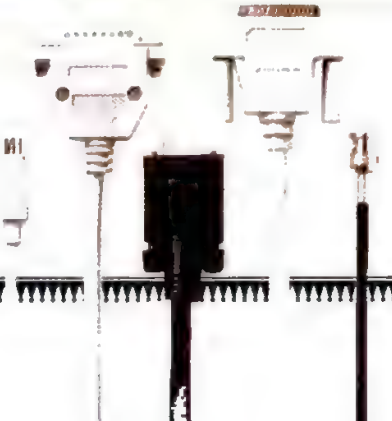
You could compare the QMS-PS 1700 to the HP III Si, but there really is no comparison.

Multi-res lets you switch between the exceptional output of 600 dpi and the speedier 300 dpi resolution.

Crown architecture. Proprietary hardware and software design that make our printers The Network Printers.

The QMS-PS 1700 printed this file in 62 seconds. The competition took 180 seconds. We're almost 3 times as fast.

Simultaneous Interface Operation, or SIO, lets the printer work over all its interfaces at once.



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Camera sample created using Micrografx Designer® software.

PostScript is a registered trademark of Adobe Systems Incorporated. All other brand names and products are trademarks or registered trademarks of their respective holders.

CIRCLE 141 ON READER SERVICE CARD

***MainLan GTi for Windows*, Version 3.31E**
MainLan Inc., 1215 North Hwy. 427, #135, Longwood, FL 32750; 800-999-6770, 407-331-4400.
List Price: 2-user starter kit (with unlimited-user software, two cards), $599.95; unlimited-user software, $199.95; card, $199 95.
Requires: DOS 3.1 or later. Server: 80K RAM. Client: 35K RAM. Peer-to-peer operation: 102K RAM in each machine.
In Short: Dependable but slow, *MainLan GTi for Windows* is a middle-of-the-road LAN that is easy to install and use. *MainLan*'s basic security features limit it to being a simple way to share files and printers among a few systems.

CIRCLE 812 ON READER SERVICE CARD

network to $1,399.75. *MainLan* supports any NetBIOS-compatible cards that include their own drivers, and a software-only package is available for $199.95; it can run on top of Novell's *NetWare* NetBIOS emulation, allowing simultaneous access to both types of LAN. Systems based on proprietary 4-Mbps and 10-Mbps adapters are also available.

MainLan provides toll-free technical support free for 90 days, from 9 A.M. to 6 P.M. E.S.T., along with a BBS. *MainLan GTi for Windows* offers a dependable DOS-based LAN system, appropriate for those whose needs do not extend much beyond sharing a few files or printers. But *MainLan*'s middling performance and lack of good security make its use in most business situations questionable.

NET/30

BY JOE SALEMI Among the low-cost LANs in this review, the best Microsoft Windows interface belongs to Invisible Software's *NET/30*. At $349 per node, *NET/30* delivers decent performance and good memory management at a midrange price. *Net/30* supports a total of 99 users per LAN.

In *NET/30*, Version 3.10, Invisible has improved performance and printing, increased the number of open files allowed on the server, and added a dedicated server mode. Unfortunately, *NET/30* is currently limited to supporting only Invisible's Ethernet cards and parallel port adapter; but thanks to a special driver, the cards are NE1000- and NE2000-compatible and can be used with *NetWare*. The driver costs $10 and is available from Invisible.

PERFORMANCE GAINS

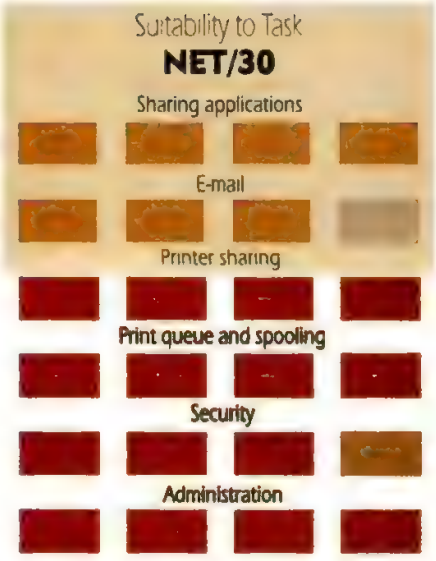
NET/30 placed in the top half on our tests in nondedicated mode. But a bug in the software skewed the results toward indicating greater performance: The load station software on the server consistently failed to start the tests, so the throughput numbers are higher than they would be otherwise. A company spokesperson was unable to come up with a reason or solution for this failure, other than that the server gives higher priority to remote requests than local ones; the company plans to investigate this further.

NET/30 includes a utility that turns a nondedicated server into a dedicated one, and running the tests in dedicated mode showed about a 10 percent improvement in performance. In both modes, the tests with the background print load set at default priority showed a small decrease in hard disk throughput, but still provided decent printer response. *NET/30* lets you adjust the priority.

A proprietary disk cache included with the package significantly enhances server performance over running the program without a cache. You can set a number of cache options through the advanced configuration screens, including delayed writes.

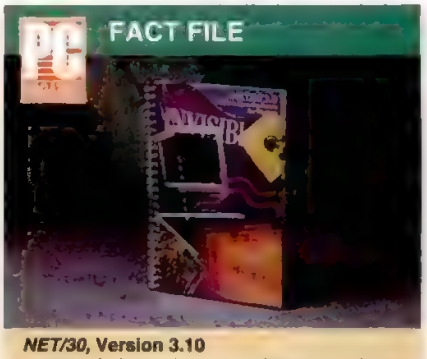
EXTENSIVE MEMORY MANAGEMENT

Both packages support a variety of memory management options; you can configure the software to load in conventional RAM, LIM EMS, extended memory, or upper memory blocks (UMBs). When loaded into conventional memory, *NET/30* used 85K for the server and 60K for the workstation on our test-bed. When we chose the extended memory option, we reduced memory requirements for both packages to a mere 320 bytes for both servers and workstations. You can free up additional RAM by using DEVICEHIGH to load the CONFIG.SYS device driver into the UMB area on systems that support it. Memory managers such as MS-DOS 5.0 and QEMM.SYS are supported, and Invisible also provides its own memory managers for 386s, 286s with Chips and Technologies chip sets, and any systems with EMS. You can reduce memory requirements on some workstations by enabling the NetBIOS ROM on the adapter boards.



Setting up a workstation as a print server requires installing the full server software, so you should only choose this option for systems that have additional memory or can afford the extra conventional RAM required.

NET/30 provides a number of options for administering both local and remote workstations and servers. Security options are available at the resource, user,



***NET/30*, Version 3.10**
Invisible Software Inc., 1142 Chess Dr., Foster City, CA 94404; 415-570-5967.
List Price: ISA version (with unlimited-user software, card), $349 per user. MCA version (with unlimited-user software, card), $469 per user. Proprietary network: with 1.8-Mbps ISA card, $199; with 3-Mbps ISA card, $299; with 3-Mbps MCA card, $399.
Requires: DOS 3.1 or later. Server: 85K RAM. Client: 60K RAM.
In Short: Dependable *NET/30* has excellent memory management options, decent performance, and a powerful Windows 3.0 interface. *NET/30* would serve well as a small to midsize LAN.

CIRCLE 813 ON READER SERVICE CARD

and group levels, and an audit trail option lets you monitor the network resources accessed by various users. While the system does not support user-level passwords, a user must be defined on the server to have access to its resources, and the resources themselves can be password-protected.

DELUXE WINDOWS CAPABILITIES

NET/30 includes a proprietary Windows 3.0 driver, and software that adds a number of features beyond Windows' built-in network support. Chief among these is the ability to have different drive and printer mappings in different DOS windows when running in 386 Enhanced mode. You can change the mappings without affecting those in other DOS sessions or in Windows itself. *NET/30* also comes with a Windows-based e-mail and BBS package that supports both private messages and public discussion groups.

NET/30's Windows interface replaces and expands on the network control icon; it lets users browse the network for available resources, add and remove file and printer redirections, configure the workstation and servers (both local and remote), and manage print queues.

UP AND RUNNING

Setting up a *NET/30* network is simple, with both easy and advanced configuration screens available. You can set up multiple configurations for a workstation and load them at the command line. You can fine-tune all network options, including NetBIOS sessions and number of open files, and open up to 999 files on the server at the same time.

Invisible sells a 16-bit, 10-megabit-per-second Ethernet card and software for one *NET/30* node for $349; a two-node starter kit sells for $698, and versions are available for either thin coaxial or twisted-pair. A Micro Channel architecture (MCA) twisted-pair version is available for $469, and Invisible also sells an eight-port twisted-pair hub for $949 and a 12-port hub for $1,195. A 10-Mbps external adapter that connects to the parallel port costs $469.

Invisible Software provides free technical support at a toll number from 9 A.M. to 6 P.M. P.S.T. Invisible's *NET/30* offers good performance, decent security, and excellent built-in memory management. Windows 3.0 users will particularly like *NET/30*'s Windows interface, and the program supports Microsoft's MS-DOS CD-ROM Extensions 2.2. *NET/30*'s main limitation is the lack of support for other network cards, but Invisible expects this to change by the time you read this review.

NetWare Lite

BY M. KEITH THOMPSON Probably the best way to describe Novell's new DOS-based LAN, *NetWare Lite*, is as a step in the right direction. Not surprisingly, *NetWare Lite* offers one of the better migration paths to Novell's more powerful network operating systems, *NetWare 2.x* and *3.x*. *NetWare Lite* also improves reliability by including an auto-reconnect feature that reestablishes network connections between a failed server and its attached clients.

Aside from these features, *NetWare Lite* lacks many of the key components of a desirable DOS-based LAN. Unlike Versions *2.x* and *3.x*, *NetWare Lite* displays mediocre performance. And *NetWare Lite* does not offer an electronic mail program or Windows support. *NetWare Lite* also lacks support for user groups, which you might want to set up for various departments in your organization. In addition, not all *NetWare* applications run with *NetWare Lite*. Finally, the software limits networks to 25 nodes and includes a frustrating copy-protection scheme.

***NetWare Lite*, Version 1.0**
Novell Inc., 122 E. 1700, South Provo, UT 84606 800-453-1267 801-429-7000.
List Price: Software $99 per user
Requires: Network cards with ODI drivers, DOS 3.1 or later. Nondedicated server 49K RAM. Client 27.5K RAM
In Short: *NetWare Lite* is a peer-to-peer LAN operating system with average performance and features. Targeted at the first-time user *NetWare Lite* provides DOS-based computers with file- and printer-sharing services. The program works with many LAN adapters and provides a smooth path for the integration of more powerful *NetWare* servers

CIRCLE 515 ON READER SERVICE CARD

As the new low-end entry to Novell's suite of network operating systems, *NetWare Lite* replaces Novell's discontinued entry-level system, *ELS NetWare*. While *ELS NetWare* offered no migration path to Novell's higher-level network operating systems, *NetWare Lite* can coexist with *NetWare* 2.2, Novell's server-based product for medium-size installations, and with *NetWare* 3.11, its high-end cross-platform solution. Most important, Novell also offers an upgrade path for *NetWare Lite* buyers.

NetWare Lite's $99-per-node software price sounds good, but since it does not include adapter cards, the real price ranges from $300 to a high $450 per node.

NetWare Lite scored in the middle of the pack on our benchmark tests with no load on the network and it slowed down as we added stations to the network. *NetWare Lite* is simply not designed for the heavy traffic of a large network. For example, *NetWare Lite*'s caching algorithm uses a limited read-ahead technique that only caches reads; most of its competitors' algorithms cache both reads and writes. With *NetWare Lite*, you will probably want to run a cache program such as MS-DOS 5.0's SMARTDRV.SYS driver or Multisoft's *Super PC-Kwik* in any PC set up as a server. We used *Super PC-Kwik* for our tests. These third-party programs take up an additional 22K to 40K of memory. Although we did not formally time performance without the cache loaded, there was a significant and noticeable improvement when *Super PC-Kwik* was added.

Without the extra cache, *NetWare Lite* consumes less RAM than many of its competitors. A client PC uses 27.5K of RAM and the server software takes 49K. Both can load into high memory with expanded memory managers. With added cache, memory requirements jump to 67.5K of RAM on the client and 89K on the server, depending on the particular cache employed.

Novell makes security simple but effective. Users have three types of access privileges: full, none, or read-only. The most useful new feature, auto-reconnect, lets you avoid rebooting a client computer if your server goes down. When the server comes back up, *NetWare Lite* automatically reestablishes the old connections. While some DOS-based LANs include this option, neither *NetWare 2.x* nor *3.x*

BENCHMARK TESTS

Hard disk caching programs and transport-layer software can make or break the performance of a low-cost LAN. For printing performance, the amount of traffic being handled by the server is the issue; some network operating systems suspend printing tasks until all network requests are completed. Note that you can expect 35 percent better performance from a network with a dedicated server than from one whose server also acts as a workstation.

PC Magazine LAN Labs' benchmark tests are written in C and are independent of commercial software. Each load station operates at a rate many times that of a typical networked PC, even one in a heavy-use environment.

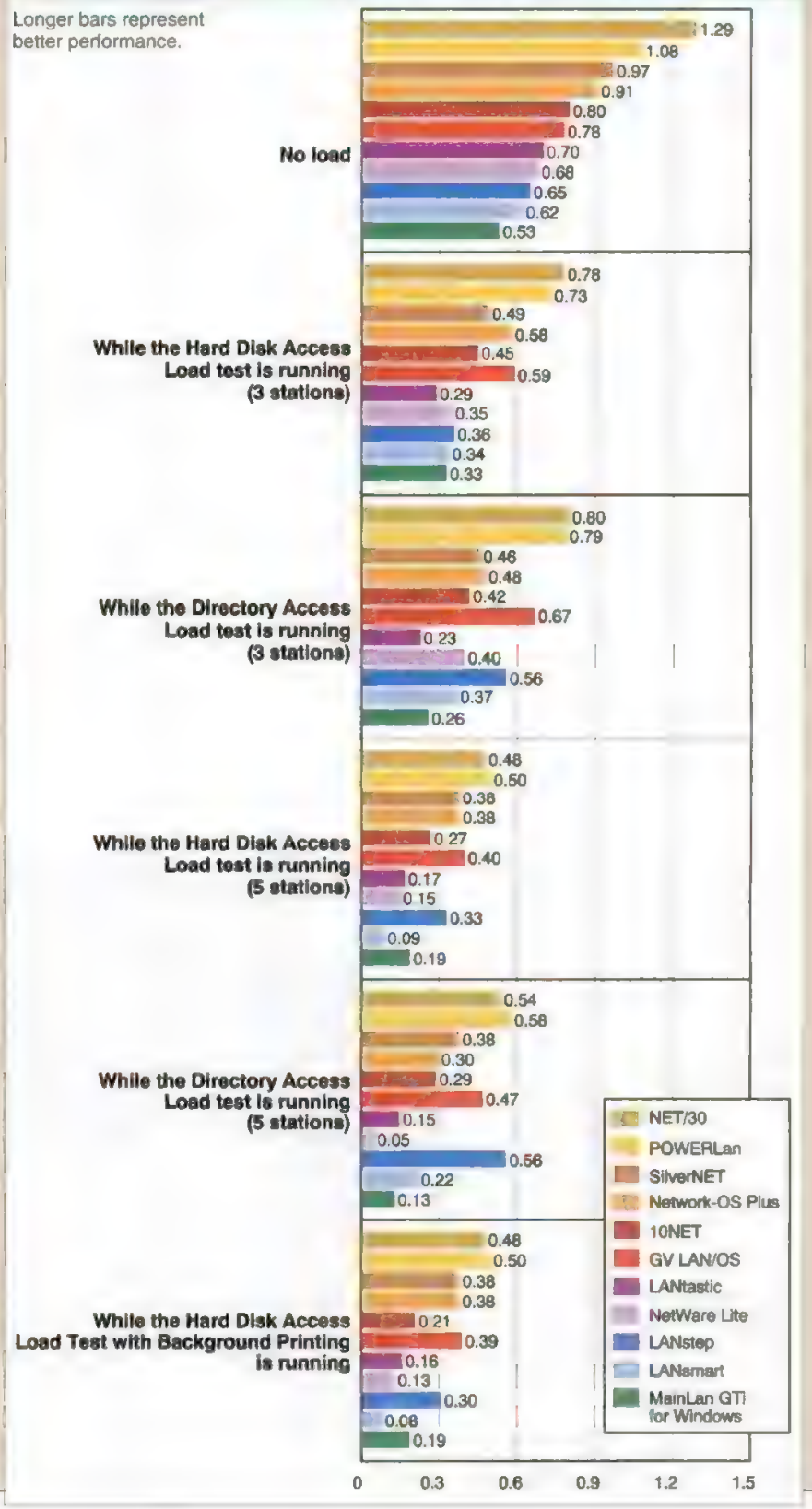
The **Workstation Throughput Evaluation** test reports the throughput recorded on a single PC during the performance of a standardized task on the network, and is run in conjunction with the Hard Disk Access Load test, the Directory Access Load test, or the Hard Disk Access Load with Background Printing test. The test program performs a sequential read, a random read, a sequential write, and a random write using a 1MB file. The record size systematically rotates among 16K, 4K, and 512 bytes. The throughput is reported in megabits per second.

The **Hard Disk Access Load** test reads random blocks of data in 1K increments from a 10K file on the server. The results of this test are reported in requests per second for all the PCs running the load test. The test begins and ends at the same time as the Workstation Throughput Evaluation test.

The **Directory Access Load** test makes the server repeatedly search for a nonexistent file. Since the file allocation table in network servers is typically cached, this request causes a fast read to the cache. The reported retries created by the client PCs generate a heavy load on the server's CPU. This test provides a general-purpose method of loading the server's CPU in the fashion of a resident task, such as a network-monitoring program or a communications program. The results for this test are reported in requests per second as an average of all the PCs running the load test. The test begins and ends at the same time as the Workstation Throughput Evaluation test.

The **Hard Disk Access Load Test with Background Printing** uses the same setup as the Hard Disk Access Load test (running on five stations), but it adds the load of a large network print job that constantly spools to a printer attached to the file server. The size of the print job is adjusted to keep it feeding to the printer throughout the load and throughput tests. The test begins and ends at the same time as the Workstation Throughput Evaluation test.

WORKSTATION THROUGHPUT EVALUATION (megabits per second)



HOW WE TESTED

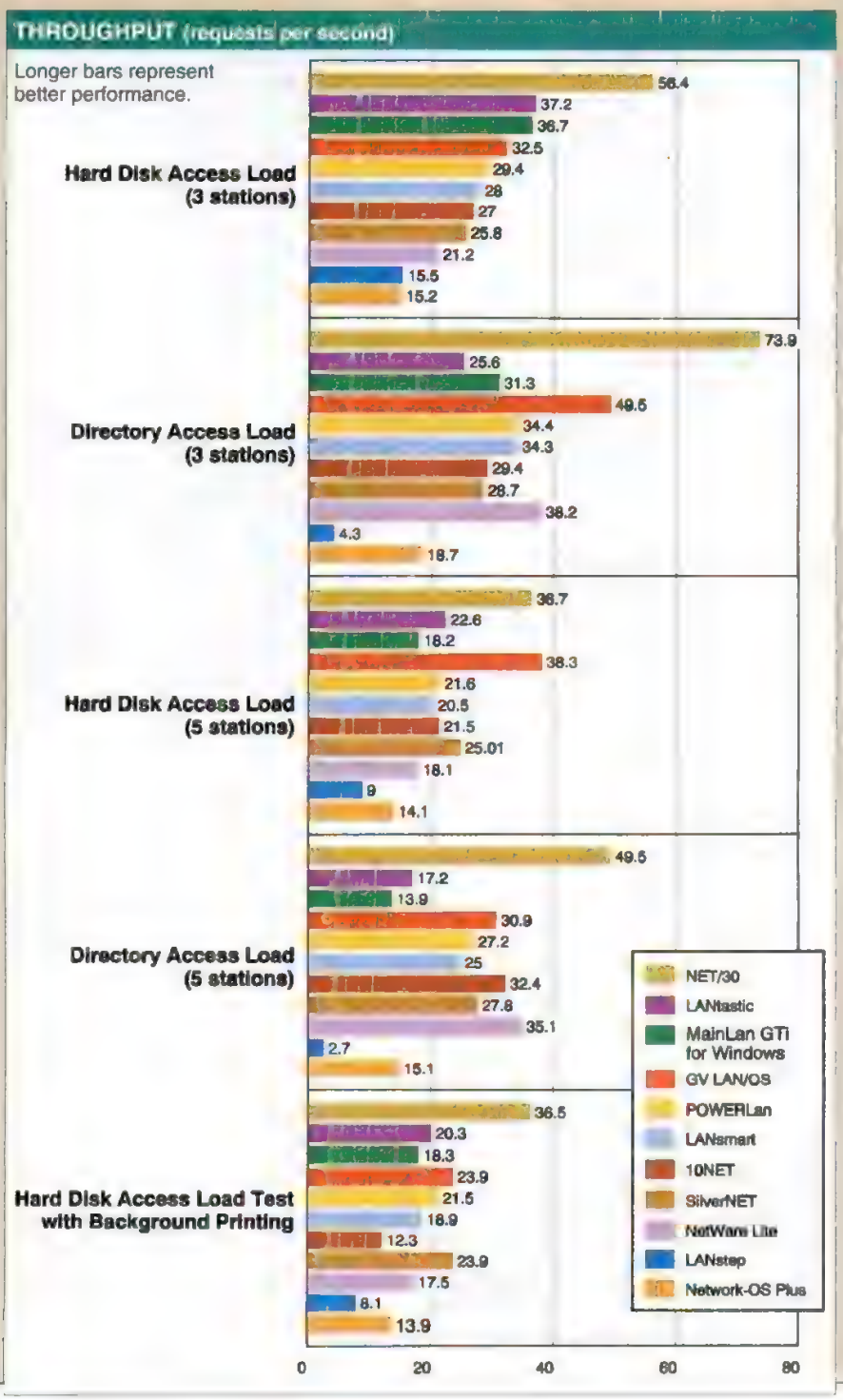
Our test-bed consisted of six Compaq Deskpro 386/n PCs, each with a 16-MHz 386 processor and 5MB of RAM. One of the Compaqs acted as the primary print and file server in nondedicated and dedicated modes. We ran the Workstation Throughput Evaluation test on a separate Compaq. All other PCs including the server ran our Hard Disk Access Load, Directory Access Load, and Hard Disk Access Load with Background Printing tests.

To connect the six Compaqs together on the test-bed, each vendor supplied us with its own network adapter cards. If no network adapter was offered, we used an NE2000 adapter. All testing was done with thin Ethernet cabling, except for D-Link Systems' *LANsmart*, which used an unshielded twisted-pair wiring scheme.

Each test scenario began with the evaluation PC running without the load of any added tasks. "No load" evaluates the network performance of a single station. The evaluation PC synchronized the PCs during all tests to get an accurate measurement of the amount of work and throughput it could handle.

Next we ran the Hard Disk Access Load and Directory Access Load tests on three and then on five additional stations, with the evaluation PC measuring its own throughput in all cases.

The first chart shows the performance measured by the evaluation PC while zero, three, and five additional workloads were placed on the load stations. During these tests, the average performance of the other networked PCs was measured in requests per second, as seen on the second chart.



WHAT THE NUMBERS MEAN

We ran PC Magazine LAN Labs' benchmark tests on 11 LAN products that fit the filter for this review. Unlike our procedure for our last review ("DOS-Based LANs Grow Up," June 25, 1991), we chose to test the products in this roundup as peers. And with Novell's entry into the lower-end market with *NetWare Lite*, we decided against using a higher-end network operating system (NOS) such as *NetWare 2.x* for comparison, as we had done last year.

A true peer-to-peer NOS is difficult to model. Consequently, our tests are designed for a nondedicated server, which handles both file-sharing and client/server environments.

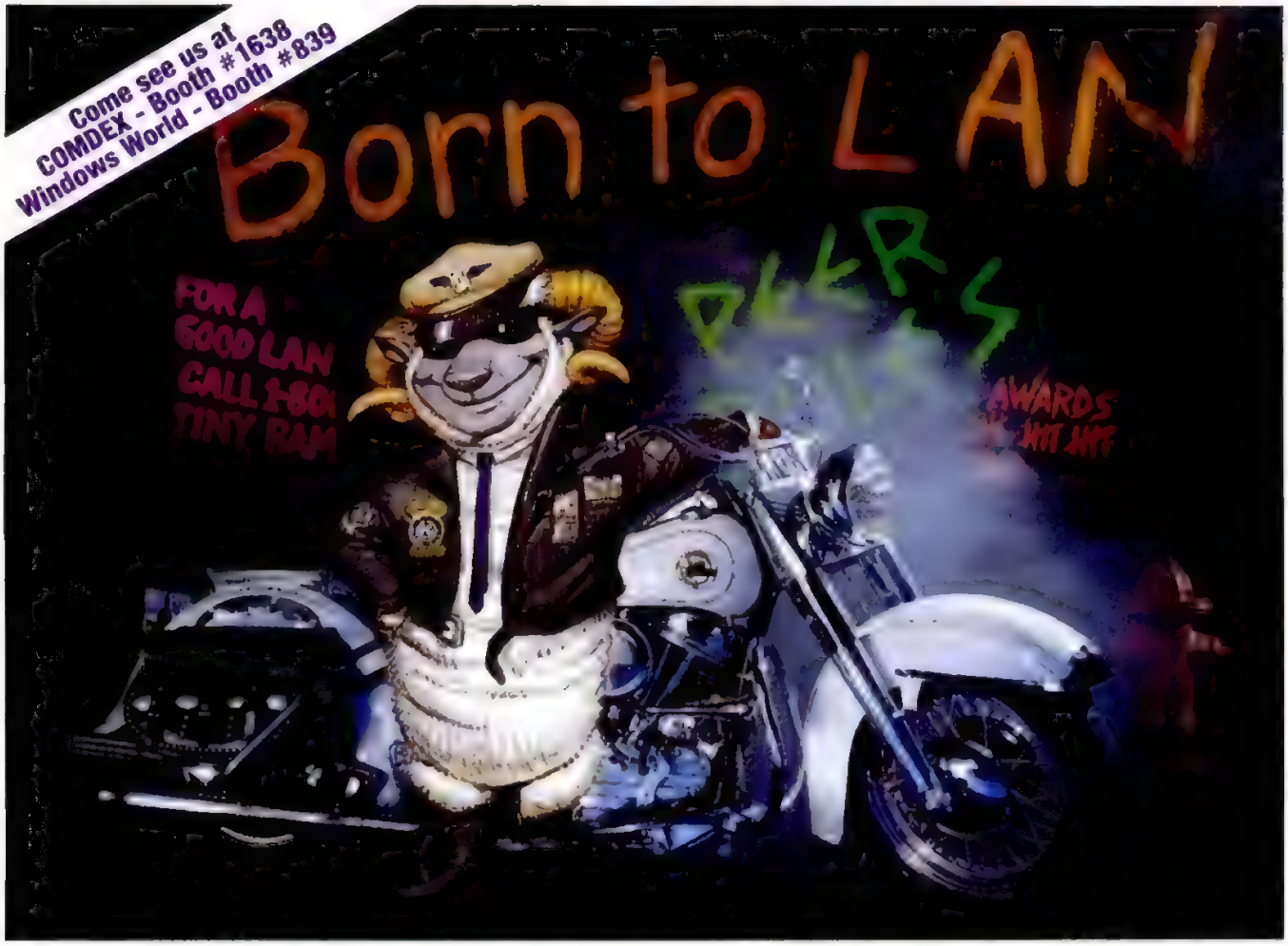
We ran the products both tuned and untuned on each of PC LAN Labs' benchmark tests; reported scores represent the tuned testing. The tests are structured in six parts. Initially, a single station issues write and read requests to the file server and the throughput of the station is measured. Then we increase the traffic load on individual workstations by running the Hard Disk Access Load test, the Directory Access Load test, or the Hard Disk Access Load with Background Printing test. We run the Hard Disk Access Load test and the Directory Access Load test on both three and five additional stations. The workstation acting as the nondedicated server is also tested as a load station.

The leaders on our throughput tests were Invisible Software's *NET/30* and Performance Technology's *POWERLan*, followed by Net-Source's *SilverNET* and CBIS's *Network-OS Plus*.

For better performance, try running the NOS on a dedicated server. On unpublished tests, products were on the average 35

CONTINUES

LEADER OF THE PACK



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PC MAGAZINE

Network Protocols:

Making Interoperability Practical

At your high school graduation you were told to cross to the podium, shake hands with your right hand, accept the diploma with your left hand, pause for the photograph, and proceed offstage. These instructions were a protocol for the transfer of a document, which in many respects resembles the networking protocols you hear so much about.

In the following pages we will compare the architectures of some of the most popular protocol stacks. By understanding the differences between networking protocols, you can more efficiently connect your computers.

partment of Defense
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dard e-mail transport
but is less functional.
changing files across

nulation and commu-

) A protocol that col-
ally runs across UDP.
tem originally devel-
zens of Unix vendors.
l that organizes pack-
accurate delivery to

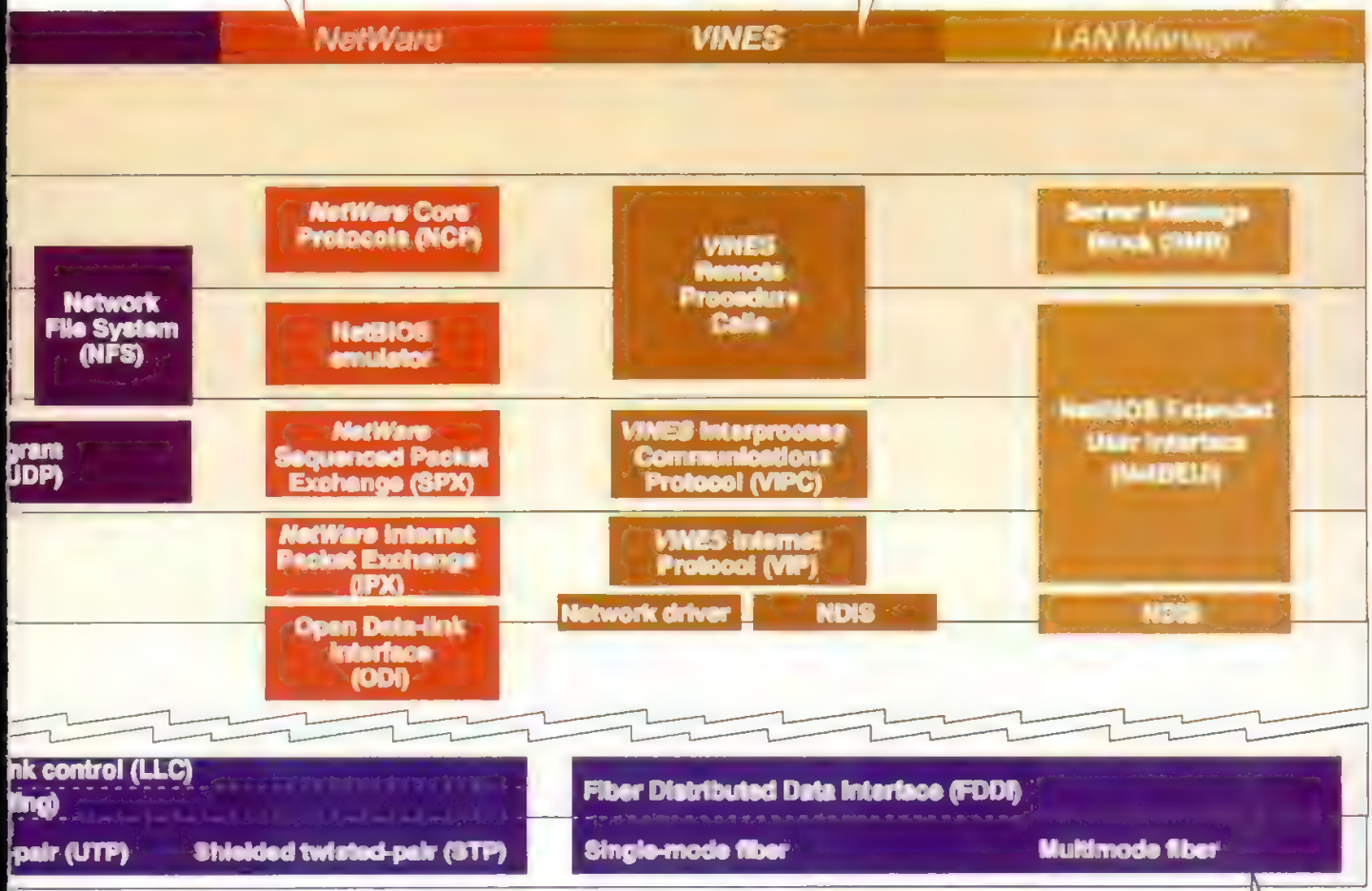
determines the final
s. UDP has less over-

s the routing of data
networks.

***NetWare* Core Protocols (NCP)** The distributed naming service used under *NetWare*.
NetBIOS emulator A NetBIOS implementation from any of a number of different vendors.
***NetWare* Sequenced Packet Exchange (SPX)** A set of commands that works on top of IPX to ensure data delivery.
***NetWare* Internet Packet Exchange (IPX)** *NetWare*'s network protocol for transmitting information between applications. IPX also exchanges data with the *NetWare* shell and with *NetWare*'s NetBIOS emulator.
Open Data-link Interface (ODI) The device driver standard from Novell.

***VINES* Remote Procedure Calls** Software that lets *VINES* call a remote service.
***VINES* Interprocess Communications Protocol (VIPC)** A transport-level protocol that allows both assured-send (datagram) and reliable message service.
***VINES* Internet Protocol (VIP)** *VINES*' native internetworking protocol. VIP is similar to IP.
Network Driver Interface Specification (NDIS) The device driver specification developed by Microsoft and 3Com. NDIS is used by *VINES* and *LAN Manager*.
NetBIOS Extended User Interface (NetBEUI) A version of NetBIOS from Microsoft.

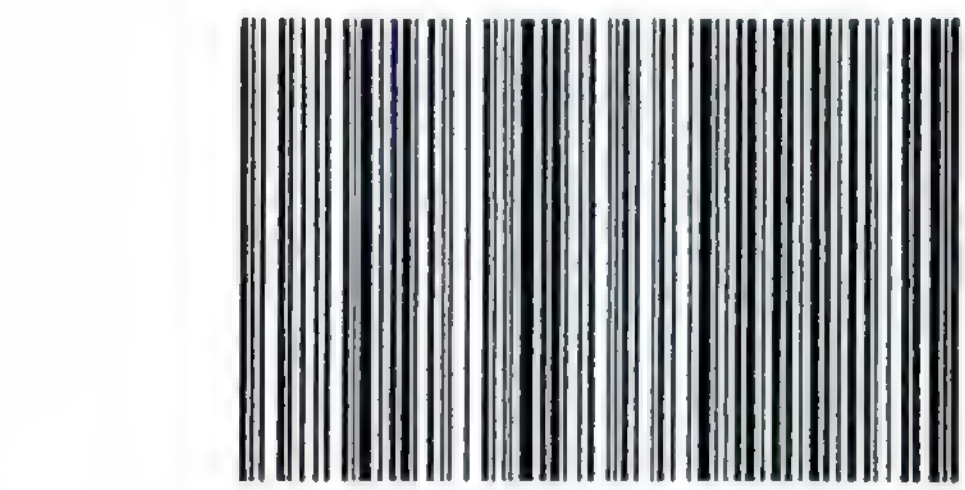
Server Message Block (SMB) A distributed file system developed by IBM, Intel, and Microsoft. A distributed file system enables an application on one PC to call a file elsewhere on the network as if the file resided on the PC's hard disk. SMB is analogous to NCP, NFS, and AFP.



nk control (LLC) The IEEE standard for software rol a data stream.
Ring) The IEEE's traffic rules for token passing at

pair (UTP) Cabling containing two or more pairs of designed to reduce electrical noise.
r (STP) Cabling with a foil shield and copper braid pairs. STP offers high-speed transmission.

Fiber Distributed Data Interface (FDDI) The ANSI specification for a LAN operating at 100 Mbps. FDDI generally operates over fiber-optic cable, though FDDI over copper cabling is also possible.
single-mode fiber Fiber-optic cabling whose narrow core diameter allows only one route for a light wave to pass through.
multimode fiber Fiber-optic cabling whose wider core diameter provides multiple routes for light waves to travel. Multimode's wider diameter prevents it from carrying signals as far as single-mode fiber.



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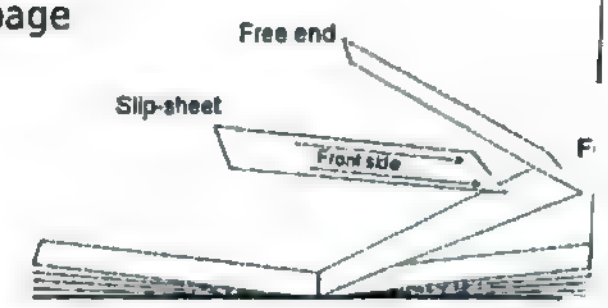
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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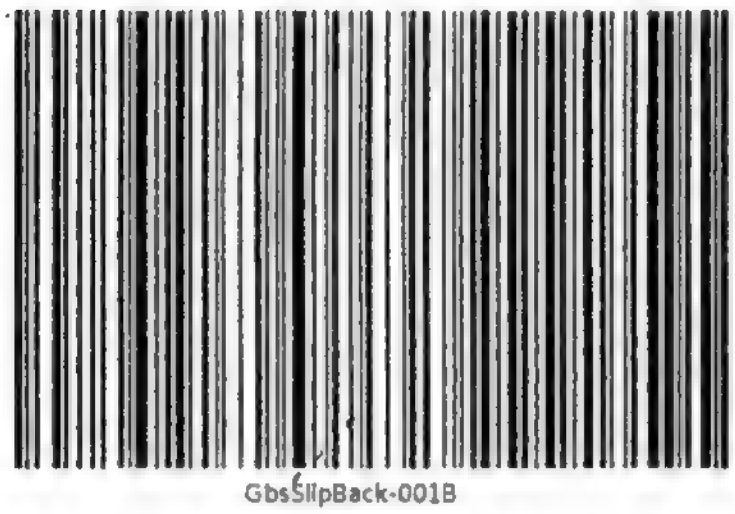
4. Close the page and slip-sheet

Inverted Back



Back

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1. Follow instructions on the other side

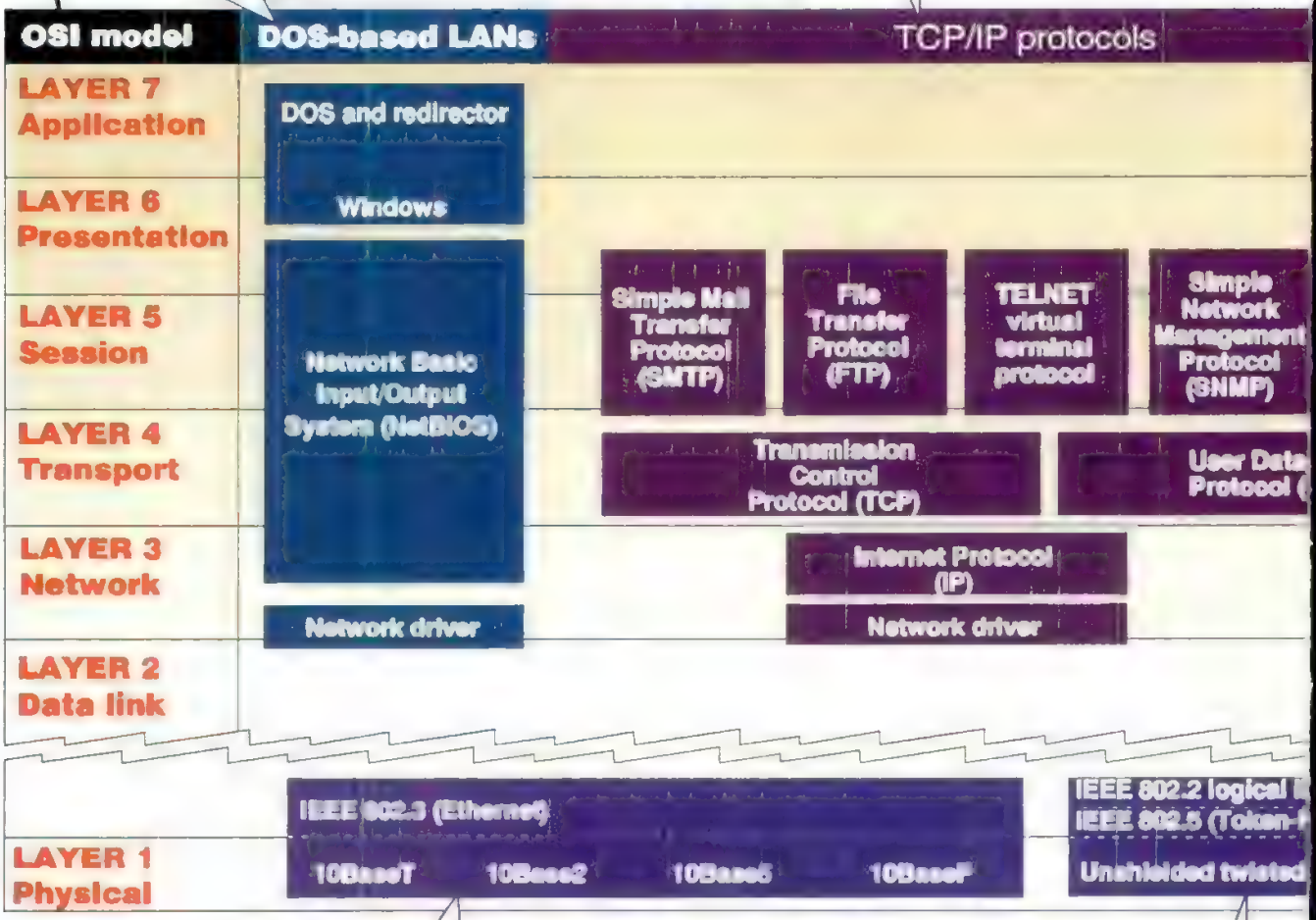
MATCHING NETWORK PROTOCOLS TO THE OSI MODEL

THE SEVEN LAYERS OF THE OSI MODEL

application layer Determines how network applications link to the network operating system. Electronic mail is an example of an application-level protocol.
presentation layer Determines how an application will format data sent across the network.
session layer Controls the flow of data between applications running on networked PCs.
transport layer Checks the integrity of network data.
network layer Establishes, maintains, and terminates the connection between two stations. The network layer is responsible for routing data between networks.
data-link layer Manages data flow into and out of network nodes, detecting network errors as they occur.
physical layer Consists of the physical connection between devices. The physical layer includes a number of elements such as the type of wiring and the electrical signals passed over the wiring.

redirector A software module that intercepts requests from an application to the operating system and routes those requests across the network.
Network Basic Input/Output System (NetBIOS) The software layer that links the network operating system to the hardware.

TCP/IP protocols Protocols developed by the De
(DoD) for connecting different computer platform
Simple Mail Transfer Protocol (SMTP) The star
for TCP/IP. SMTP is roughly equivalent to X.400
File Transfer Protocol (FTP) A protocol for ex
TCP/IP. FTP is similar to ISO's FTAM.
TELNET virtual terminal protocol A terminal e
nications program for TCP/IP.
Simple Network Management Protocol (SNMP
lects and reports network information. SNMP typic
Network File System (NFS) A distributed file sy
oped by Sun Microsystems and now licensed by do
Transmission Control Protocol (TCP) A protoc
ets, manages their transmission, and ensures thei
the receiving station.
User Datagram Protocol (UDP) A protocol tha
routing for messages reaching application progran
head than TCP but is not as reliable.
Internet Protocol (IP) A protocol that manage
packets between stations on the same or different



IEEE 802.3 (Ethernet) The traffic rules governing the IEEE version of Ethernet, a 10-Mbps cabling and signaling scheme. 802.3 is subtly different from Ethernet in data structure, but the terms are typically used interchangeably.
10BaseT The IEEE specification for running 802.3 over unshielded twisted-pair cabling.
10Base5 The IEEE specification for running 802.3 over thick coaxial cable.
10Base2 The IEEE specification for running 802.3 over thin coaxial cable.
10BaseF The IEEE specification for running Ethernet over fiber.

IEEE 802.2 logical li
and firmware to cont
IEEE 802.5 (Token-
4 Mbps or 16 Mbps.
unshielded twisted-p
twisted copper wires
shielded twisted-pai
surrounding the wire

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—Doug Gold, director of communications research at International Data Corporation, as quoted in LAN TIMES, April 15, 1991

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—Frank Dzubeck, president, Communications Network Architects, Inc., October, 1991

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MATCHING NETWORK PROTOCOLS TO THE OSI MODEL

The seven layers of the Open Systems Interconnection (OSI) model are a paradigm for picturing the various network elements. Not every network conforms to the model completely. For example, the network layer is often unused in peer-to-peer LANs. While the model is a useful structure for discussion of the differences between networks, it often does not describe how companies have designed their network protocols.

Protocols are sets of procedures implemented in software or in firmware for delivering data across a network. A group of protocols is called a protocol stack. Vendors have developed their own protocol stacks and formal organizations such as the Institute of Electrical and Electronics Engineers (IEEE) also specify standard protocols.

The NetBIOS protocol, originally designed for IBM's *PC LAN*, is a prime example of how real implementations of the protocol do more than the model allows. NetBIOS clearly belongs at the session layer, since it controls the flow of data between two networked PCs. *NetWare* and *LAN Manager* use a NetBIOS interface to provide service across the network on top of IPX and a modified version of Xerox Network Services (XNS), respectively. You will also find NetBIOS on top of the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) in the TCP/IP protocol stack. But in products such as *LANtastic*, the NetBIOS software package reaches all the way down to the media-access control layer, where it directly addresses the LAN adapter.

Some interpreters of the OSI model put functions such as distributed file systems into the category of applications; examples are Apple's AppleTalk Filing Protocol (AFP), Novell's *NetWare* Core Protocol (NCP), Sun Microsystems' Network File System (NFS), and Microsoft's Server Message Block (SMB). Distributed naming systems enable an application running on a PC to address remote files and resources as if they were local; the DOS redirector belongs in this category. But real products with these functions also have presentation-level functions.

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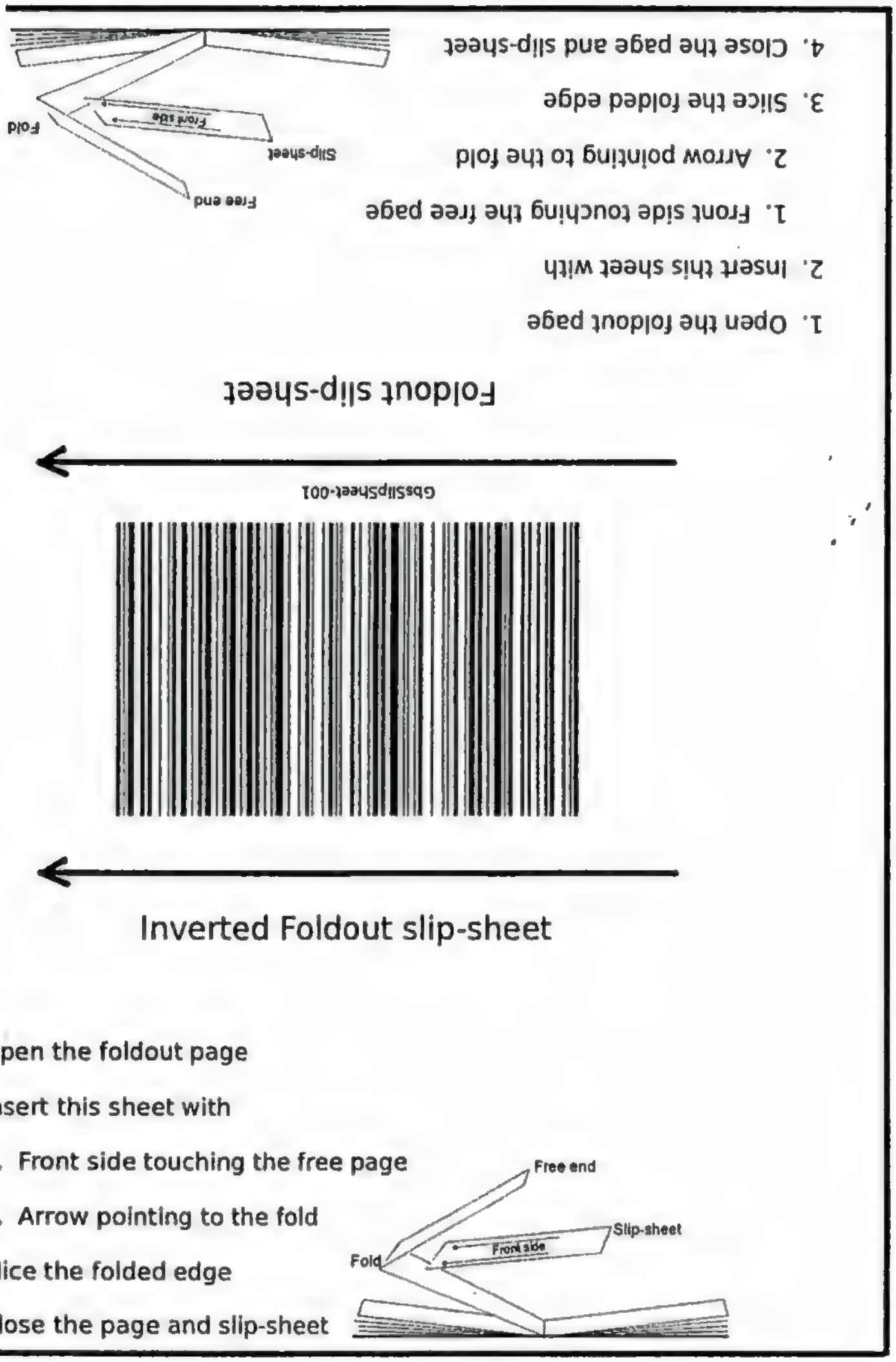
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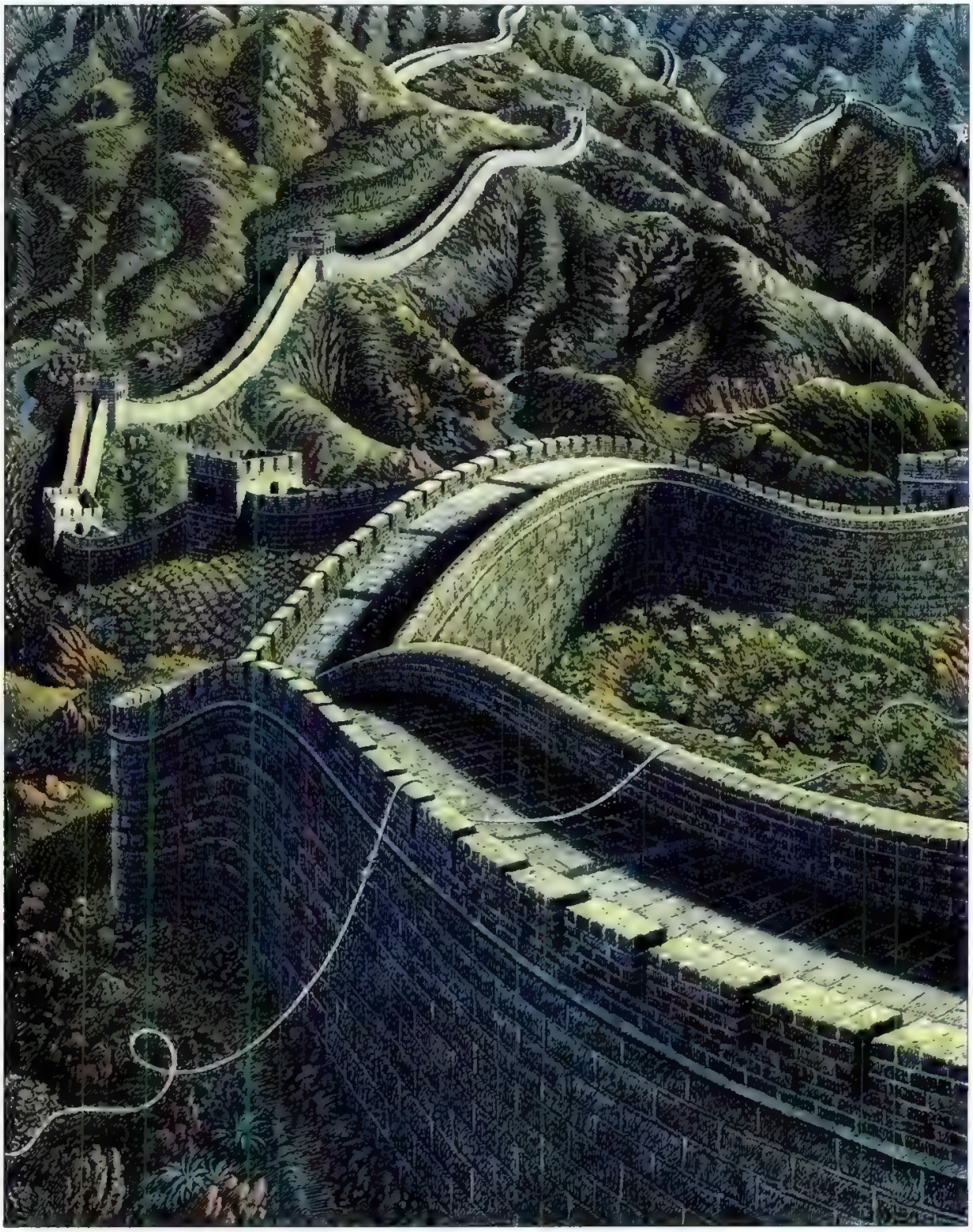

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WHAT THE NUMBERS MEAN

CONTINUED

percent faster when running as dedicated servers than when running as nondedicated servers. Both *LANtastic*, from Artisoft, and *POWERLan* provided 50 percent more throughput as dedicated servers.

Whether the NOS runs on a dedicated or nondedicated server, our benchmark tests show that performance hinges largely on the product's hard disk caching program and its transport-layer software. The caching program enhances a NOS's ability to service writes because the product writes to high-speed memory and not to the slower hard disk.

The transport-layer software increases performance by eliminating overhead in the creation, transmission, and reception of a packet. *NET/30*'s TransBIOS is one example of an effective transport layer. Instead of using multiple transactions to complete a single task (as required by other transport layers), TransBIOS completes the task with a single transaction. Other companies, such as Artisoft, NetSource, and Performance Technology, tune NetBIOS for higher performance.

On our tests, printing performance varied according to the amount of traffic serviced by the file server. Our Hard Disk Access Load Test with Background Printing simulates what can happen when an added task such as a print job is placed on a heavily loaded server. During our test we found that some network operating systems tend to give higher priority to fill service and lower priority to printing. Some products suspended the printing task until all network requests were completed.

ENDS

offer it. Novell should provide this type of functionality in its higher-end *NetWare* versions.

MIGRATION PATH

As a rule, *NetWare Lite* runs applications designed for *NetWare* 2.*x* and 3.*x*, as long as they use Novell's IPX communication protocol. But there are some exceptions. *NetWare Lite* will not run *NetWare* applications that rely on the Novell Bindery, such as Intel's *LANSight Support* network management program, and the LAN Support Group's *BindView Plus* report generator. The reason is simple: The Bindery, a database of users and resources used in *NetWare* 2.*x* and 3.*x*, is not offered in *NetWare Lite*.

NetWare Lite also does not include SPX, Novell's more advanced communication protocol. This means that *NetWare Lite* will not work with programs that rely on SPX, such as Novell's PSERVER print server utility.

Further interoperability is enabled thanks to TransBIOS, a version of NetBIOS that runs on top of IPX. Calling this interface program lets you use network versions of applications and communicate with other NetBIOS nodes on the same network. *NetWare Lite*'s NetBIOS can also talk to other NetBIOS clients on other networks, such as the NetBIOS that Novell offers in *NetWare* 2.*x* and 3.*x*. The NetBIOS program uses 29K of RAM and can be loaded into high memory.

To access *NetWare* 3.*x* or 2.*x* resources, *NetWare Lite* client PCs simply load the 41K NETX.COM program. To access *NetWare Lite* resources, *NetWare* 2.*x* and 3.*x* client PCs load the 12.6K CLIENT program. A better means of integration would allow *NetWare* 2.*x* and 3.*x* clients to see *NetWare Lite* resources without loading the CLIENT program on their PCs. Additionally, *NetWare* and *NetWare Lite* use different commands to connect to and use resources, making interoperability potentially confusing.

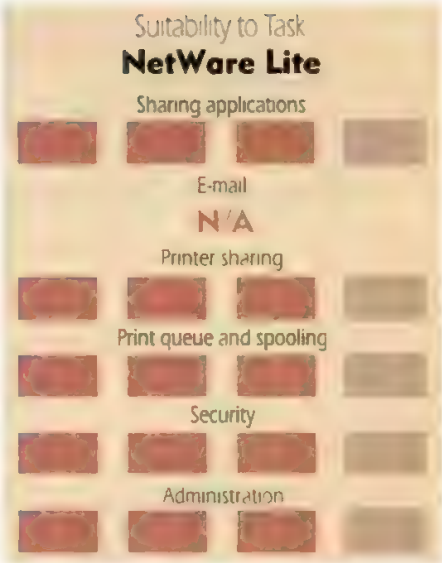
NetWare Lite does not integrate well with Microsoft Windows, since the Windows setup program will not recognize it as a *NetWare* network. Novell needs to offer software drivers to make Windows aware of *NetWare Lite*, so it will allow Windows' File Manager and Print Manager to make connections and manipulate the print queues.

For printing, at least, a workaround is available. You can tell Windows to use LPT1.OS2 instead of LPT1 and then redirect the print job to the *NetWare Lite* printer.

COPY-PROTECTED INSTALLATION

Installing the software and network interface card takes about 10 minutes per node. *NetWare Lite* comes with drivers for over a dozen different cards. The easy-to-understand documentation makes *NetWare Lite* a snap to set up and use.

One major drawback is a copy-protection scheme that forces you to install *NetWare Lite* from a different disk for each computer. You cannot just carry a single configured floppy disk from PC to PC. If two computers on the network have the same copy installed, both report a "License Violation" message periodically on the screen. Copy protection of this nature imposes a long-term management effort, because someone must keep track of the pairing of each installation disk with each computer.



NetWare Lite provides both a menu-driven program and a command line program to set up the sharing of and use of network services. You can log on to servers, redirect drive letters and ports, display and control print queues, and send short messages. *NetWare Lite* also supports Microsoft's MS-DOS CD-ROM Extensions 2.2.

Novell's primary support channel is through *NetWare Lite* dealers. The company also supplies installation support over a toll telephone number and ongoing support through a 900 number. The Novell forums on CompuServe are an active source of support for all Novell products.

Network-OS Plus

BY STEVE RIGNEY CBIS took an interesting approach with *Network-OS Plus*, Version 7.26C: It equipped a decently performing package with some surprisingly sophisticated features such as LAN monitoring, modem sharing, and *LAN Manager* compatibility.

Network-OS Plus does not contain standard features such as e-mail and messaging, however. And while *LAN Manager* compatibility gives you hooks into a non-DOS-based LAN, it does not enable you to connect to the more popular non-DOS-based network operating systems *NetWare* 2.*x* and 3.*x*.

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Rising up from Salisbury Plain in England, Stonehenge is a mystery. Theories about its creation include a primitive "duplication" of Roman architecture to an observatory for tracking the movement of stars. Even more intriguing is how the ancient craftsmen could move the massive blocks, stand them up and balance another stone on top of the pillars. And how were they able to perfectly align the stones so the sun would shine through particular columns during equinoxes? These mysteries may never be solved.

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One advantage to *Network-OS Plus* is its adherence to industry-standard protocols. Standard protocols ensure greater flexibility. NetBIOS, for example, allows you to use other vendors' adapters, assuming they have NetBIOS drivers.

Network-OS Plus also uses the MS-DOS network functions, giving you file- and record-locking capabilities. And the SMB protocol enables a *Network-OS Plus* client to log on to a *LAN Manager* server.

Network-OS Plus boosts performance with PCCache, a disk-caching program that permits program and data file access across the network at the maximum speeds possible. *Network-OS Plus* achieved respectable performance numbers on our benchmark tests.

The amount of memory used for both the server and workstation programs is reasonable: They require 56K to 66K and 31K to 41K, respectively. The memory requirements vary, depending on whether a PC is configured as only a print server or only a file server. Unlike most DOS-based LANs, if you decide not to load the print server functions with *Network-OS Plus*, you release approximately 13K of RAM for applications.

Security for *Network-OS Plus* takes the form of password protection and encryption. Redirection and resource usage information is stored in a user "Personalities" file and is transportable over the network; users can easily move all their shared resource information and redirections to any node on the network.

You can adjust the *Network-OS Plus* server to be completely dedicated to network tasks, or you can enable the server's CPU to allocate all or a fraction of its working time to network tasks. If a server gets disabled or rebooted, workstations automatically reconnect upon subsequent network requests.

Although *Network-OS Plus* does not come with electronic mail and CD-ROM sharing, CBIS offers these capabilities and support for Microsoft's MS-DOS CD-ROM Extensions 2.2 as optional packages. *Network-OS Plus* does include support for drive and communications port redirection, printer sharing, print-queue maintenance, modem sharing, bridging, and peer-to-peer capabilities. You can execute all of these utilities either from menus or the DOS command line.

BUNDLED MONITORING PROGRAMS

CBIS bundles several interesting programs for monitoring and maintaining the net-

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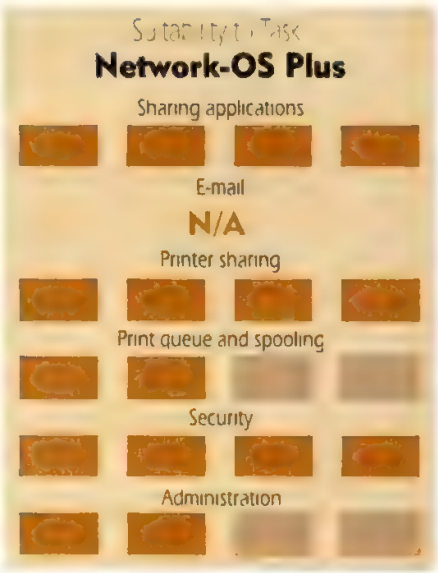

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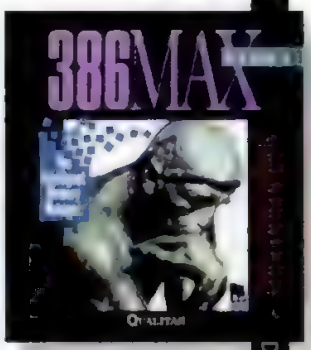

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© 1992 Qualitas. Qualitas, 7101 Wisconsin Avenue, Suite 1386, Bethesda, MD 20814. *All company and product names are trademarks or registered trademarks of their respective owners.* **System Requirements: Any 386, 386SX, 486 or 486SX PC or PS/2, min. 256K of extended memory, DOS 3.0 or higher, and hard disk drive. (386MAX also supports 286 machines with Shadow RAM, or any PC with EMS 4.0 hardware with 256K memory. Feature availability and memory recovery may vary on these systems.)**

CIRCLE 258 ON READER SERVICE CARD

***Network-OS Plus*, Version 7.26C**
CBIS Inc., 5875 Peachtree Industrial Blvd., Bldg. 100, #170, Norcross, GA 30092; 404-446-1332.
List Price: 8- to 80-user software, $1,988.
Requires: DOS 3.1 or later. Server: 56K RAM. Client: 31K RAM. Peer-to-peer operation: 56K RAM.
In Short: *Network-OS Plus* has excellent modem-sharing capabilities and a network maintenance program called RADAR. Unfortunately, the absence of many other standard features such as e-mail and CD-ROM sharing detract from the product's viability. *Network-OS Plus* has some excellent features for a low-cost LAN, but it still needs improvement.

CIRCLE 516 ON READER SERVICE CARD

work with *Network-OS Plus*. RADAR is a network resource analyzer that you can execute from the DOS prompt or load as a 20K TSR program. You can use RADAR to manage and modify network resources such as shared drives and printers to examine any network user's available resources, and to add or delete local workstation and server resources. RADAR can also display local or remote network adapter card statistics in bar graph form. Using the SNOOP and SNOPEE programs, the supervisor can access a mirror image of any user terminals on the network and conduct interactive exercises or simply monitor the users' network activity in progress.

Network-OS Plus Modem Sharing is a communications package designed to allow users on a LAN to share a single modem. CBIS's $995 *OutBound Plus*, Version 2.0A, allows you to expand this capability to up to 20 modems.

Installing *Network-OS Plus* is simple, and the process allows you to set up both the server and workstation PCs to make use of either extended memory, UMB (upper memory blocks), or conventional memory.

Although CBIS does not market its own network adapters, *Network-OS Plus* supports over 50 network adapters with NetBIOS drivers. Support for MS-DOS includes file and record locking, device redirection, and network detection capabilities. SMB support enables *Network-OS Plus* workstations to access other CBIS products, as well as Microsoft's OS/2 *LAN Manager* servers.

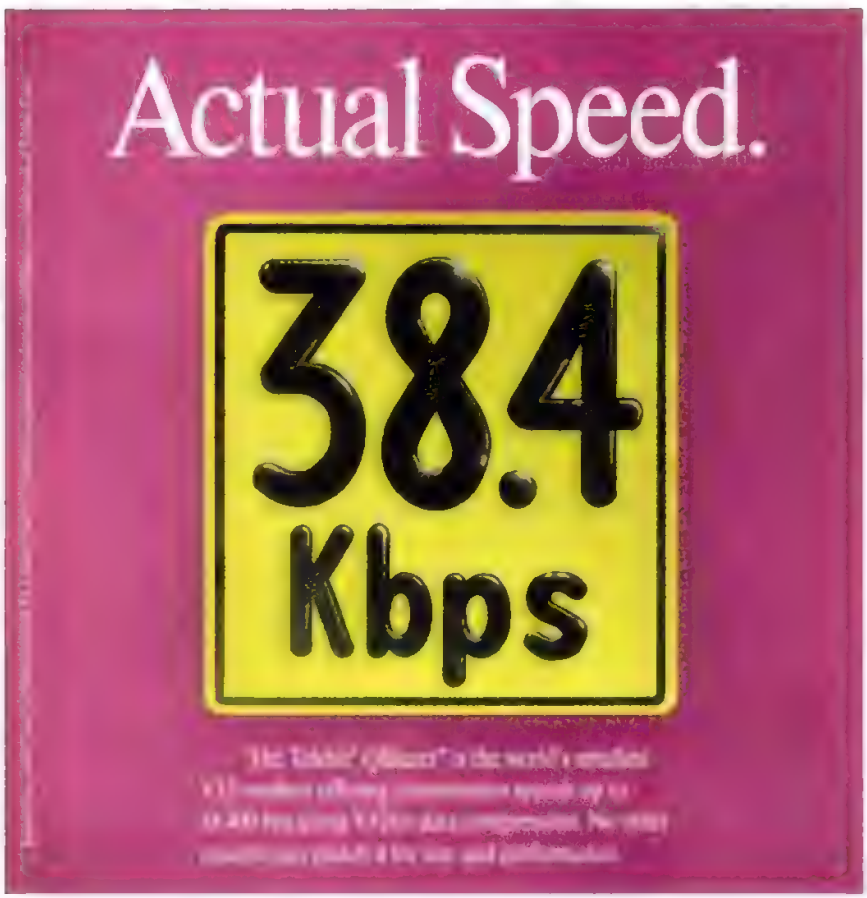
CBIS offers free technical support weekdays from 8:30 A.M. to 7:30 P.M. E.S.T., on-site training for its products, and a BBS.

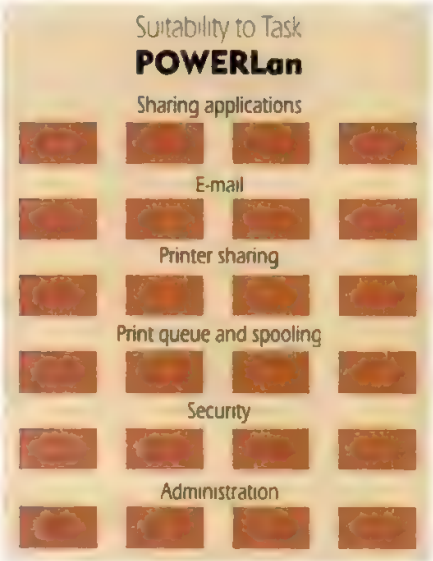
Network-OS Plus is a basic network operating system with a relatively high price tag. The absence of built-in features such as mail and CD-ROM sharing hurt CBIS in the race for the top. The addition of modem sharing and network diagnostic and monitoring utilities is a start, but more development needs to go into the product before it can really compete.

POWERLan

BY JOE SALEMI *POWERLan*, Version 2.20, may well have moved up to the same class as *NetWare* and *LAN Manager*. An Editors' Choice winner in our last roundup of DOS-based LANs, Performance Technology's *POWERLan* keeps up its winning ways in its latest version, maintaining excellent performance, versatility, and easy installation and use.

POWERLan 2.20 adds a number of new security and network administration features, along with support for accessing OS/2 Named Pipe applications, such as SQL database servers. New network driv-





ers provide support for NDIS, ODI (Open Data-link Interface), and Clarkson Packets, increasing the number of supported cards and topologies to just about all available on the market today. *POWERLan* can interoperate with many types of networks, including *LAN Manager, NetWare,* and NFS over Unix. In our six-station test configuration, the software cost $132.50 per node. Combining software with a $295 adapter raised the cost to a pricey $427 per node, though less expensive adapters are available.

POWERLan remains one of the fastest DOS-based LANs around. It had the highest throughput in dedicated mode and came in second in nondedicated mode. The background printing job had no effect at all on hard disk access on the dedicated server and had only a minor effect on the nondedicated server; printing speed was very good in both modes.

In our test configuration, using EXOS twisted-pair Ethernet cards and drivers ($295), the server software took up 66.5K RAM, plus 46K for the included disk cache. The workstation software used up 43K, including the EXOS drivers. If XMS (extended memory specification) memory is present, you can load the redirector portion of the software there and leave only 1.1K behind in conventional RAM.

We could load all except the EXOS drivers into high memory with MS-DOS 5.0, significantly reducing the required RAM. Setting up a workstation as a print server takes only 3.5K RAM, as the workstation only acts as an unspooler; the main print spooler logic and files reside on the file and print server.

ENHANCED SECURITY

Performance Technology has enhanced security in *POWERLan* by using multiple log-on servers that maintain information about a user or group's access rights and that automatically update each other during various events. You can restrict user log-ons on a daily time schedule and force users to change their passwords periodically. You can set up accounts that expire after a certain date, and password-protect both the server and the local configuration menus.

Several add-on modules increase the flexibility of *POWERLan* networks. The $995 *POWERSave* package lets a workstation back up dedicated servers. For $695, *POWERMirror* adds disk-mirroring capabilities to dedicated servers, and the $995 *POWERBridge* lets you bridge multiple NetBIOS networks, either locally or through X.25 or async remote connections. And *POWERFusion* allows connections to Unix-based systems for file and printer sharing (pricing depends on the platform and number of connections supported).

INSTALLATION AND ENHANCEMENTS

Installing and configuring *POWERLan* is easy; a point-and-shoot utility steps you through the choices. Once up and running, you use the PLADMIN utility to add users and groups, set up shared resources, and configure the server's disk cache and other parameters. A server can be dedicated on a 386 or 486 system, or nondedicated on any DOS system; you can also administer dedicated servers remotely.

The PLQ utility gives users and administrators complete control over print jobs, including redirecting them to different printers and restarting a job from any point within the utility. *POWERLan* offers the ability to define different forms and classes of printers, create enhanced banner pages and printer control se-

FACT FILE
EDITORS' CHOICE

***POWERLan*, Version 2.20**
Performance Technology Inc., 800 Lincoln Center, 7800 IH 10 West, San Antonio, TX 78230; 800-327-8526, 512-349-2000.
List Price: Base package (5 users per dedicated server), $795. 10 additional users per server, $995. 255-user version, $3,195 Upgrade to base package from Version 2.1, $99; 10-user upgrade, $198; 255-user upgrade, $395.
Requires: Supported network adapter, DOS 3.3 or later or DR DOS 6.0. Dedicated server: 640K RAM, up to 32MB extended memory. Client: 12.5K RAM. Peer-to-peer operation: 23.7K RAM.
In Short: *POWERLan* is a powerful and versatile LAN that offers high performance and excellent security. It also supports several network cards and topologies and provides a number of communications options.
CIRCLE 517 ON READER SERVICE CARD

CIRCLE 214 ON READER SERVICE CARD

quences, and specify that certain jobs go to certain printers. A 9K pop-up utility lets users switch printer redirections on the fly; it can also be configured to switch drive mappings. The included NETview and NETshow programs let a user or administrator take over any other system on the LAN and monitor on-screen activity or assist users with problems. You can also use the programs to monitor the statistics screen on a remote dedicated server.

The basic software package for *POWERLan* costs $795 for unlimited users on nondedicated servers, with a limit of five users on each dedicated server. An additional 10 users per dedicated server costs $995, and $3,195 buys an unlimited version that supports up to 255 users on each dedicated server. The package comes with drivers for over 30 Ethernet cards, including the Xircom Pocket Ethernet Adapter, and a similar number of ARCnet cards. NetBIOS support is provided for MS-DOS, DR DOS 6.0, and OS/2. The NDIS, ODI, and Clarkson Packet drivers support many types of cards, including Token-Ring networks compatible with IBM's *PC LAN. POWERLan* uses the SMB and NetBIOS protocols, which let it interoperate with networks such as *LAN Manager* and IBM's *PC LAN.* It also supports Microsoft's MS-DOS CD-ROM Extensions 2.2.

POWERLan's base package includes an eight-user DOS version of cc:Mail.

POWERLan's base package includes an eight-user DOS version of *cc:Mail; POWERSave* local backup software compatible with QIC and QIC-SCSI tape backups; and Performance's NAVIGATE utility for easily managing local and remote hard disks and resources. The NPLite client-side software takes a low 8K of additional RAM and includes support for Named Pipes, an interprocess communications standard allowing applications to use network resources transparently. The OS/2 server-side package costs $295 and includes the DOS NPLite software. A version for other NetBIOS LANs is available for $395.

Complete on-line help containing the full text of the manuals makes *POWERLan* easy to set up and use. The help is context-sensitive, even for error messages, and full-text search capabilities let you hunt for any topic. Performance Technology also offers toll-free technical support, without charge for the first 90 days, from 8 A.M. to 5 P.M. C.S.T.

SilverNET

BY GARY BERLINE Net-Source's *SilverNET*, Version 2.0, is a rapidly developing DOS-based LAN that touts better performance, tighter code, and better print control than previous versions. The program also includes remote management and auto-reconnect capabilities. While lacking the robust feature set of some of its competitors, *SilverNET* compensates with interoperability. Costing $99 per node for the software and about $349 per node in our test configuration, *SilverNET* provides good speed at a reasonable price.

The product's strongest feature, interoperability, derives from its use of the SMB (Server Message Block) protocol to support basic file, messaging, and printer functions between *SilverNET* and platforms running OS/2 or those supporting SMB servers such as Sun and flavors of Unix. Net-Source extends the capability with its own SMB dialects, but only when no published formats exist; the vendor claims that it avoids compromising compatibility.

On our benchmark tests, *SilverNET*'s new disk cache placed it among the swiftest nondedicated servers and at the upper midrange of dedicated configurations, while snipping just 3.5K from DOS memory. Options include storage to extended or expanded memory and cache size adjustment. You can change the cache's default from write-through to faster delayed writes, but you risk corrupting data if the server fails. *SilverNET* reduces the danger by writing during idle CPU time.

Compared with other DOS-based LANs, *SilverNET*'s performance held up well under increasing load, dropping evenly but not precipitously. Processing as a percentage of no-load throughput fell off far less than with most challengers in our background print test.

Version 2.0 can use expanded memory, upper memory blocks, or the high-memory area, leaving a scant 4.5K in lower RAM for servers and 1K for workstations. Even when loaded in the DOS area, the program and NetBIOS occupied only 32K in servers, and a bare 16K in workstations, less than most rivals.

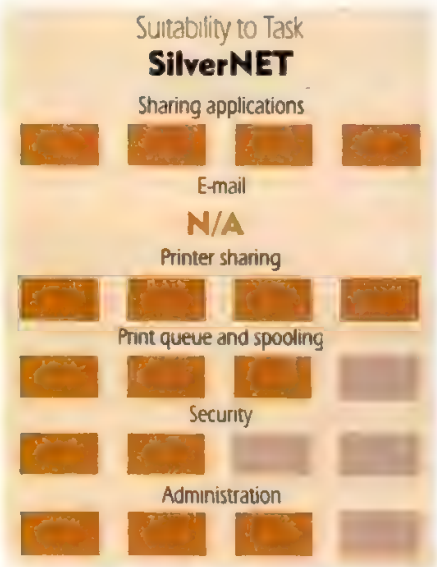
ENHANCED SECURITY

Improvements in *SilverNET*'s security place it above average. New flags restrict resource browsing and subdirectory use as well as renaming and deletion of files. Sharing and management of resources require logging on to the server with a password. You can also choose to password-protect published devices. But no facility exists to create users or workgroups.

SilverNET builds in some convenience features, including auto-reconnect of workstations when a crashed server comes back up. A node disconnect occurs two minutes after a session loss to guard against a locked file being left open on the server and made inaccessible.

The user interface is straightforward. To use a shared resource, you need only give its name. Utilities work from the DOS prompt and menus. Net-Source also plans to bundle a Microsoft Windows version with the package before this issue hits the stands. *SilverNET* managed to run Windows in 386 Enhanced mode over our test-bed without using special drivers.

SilverNET lacks some features of older DOS-based LANs, such as a remote boot



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***SilverNET*, Version 2.0**
Net-Source Inc., 1265 El Camino Real, #101, Santa Clara, CA 95050, 408-246-6679
List Price: Starter kit (with two 16-bit Ethernet cards, 2-user software, cabling, terminators, connectors), $699, kit with one card, $349. Software, $99 per user; 254-user version, $2,299; upgrade for all nodes past 20, $300.
Requires: Supported network adapter, DOS 3.3 or later. Server: 16K RAM. Client: 32K RAM.
In Short: *SilverNET* offers easy setup and fast operation at a reasonable price. While offering fewer traditional features than some of its competitors, *SilverNET* blazes its own trail toward interoperability.

CIRCLE 518 ON READER SERVICE CARD

option, UPS monitoring, e-mail, and chat. It relies only on NetBIOS (and emulators), foregoing multiple protocol stacks.

SLICK FEATURES

Plenty of slick features polish *SilverNET*'s few tarnished spots. A powerful administrative capability, called *remote log-on*, allows management from any station, letting you view open files and sessions, and close them. It also supports Microsoft's MS-DOS CD-ROM Extensions 2.2.

An excellent installation routine takes you through parameter setup quickly and simply. The hardware setup program senses free interrupts and even displays drawings of the adapter switches and jumpers it recognizes.

SilverNET's print queue functions let you shuffle the priority of print jobs, restart jobs, reassign queues, and display their progress. The program allows you to create a customizable separator page and, most impressively, offers support for redirection to up to 16 printers.

Net-Source sells a $699 Ethernet starter kit for connecting two PCs, including a pair of 16-bit adapters compatible with NE2000 cards, allowing migration from *SilverNET* to *NetWare*. Single-node expansion packs come with either a $329 16-bit or $299 8-bit adapter. Software alone costs $99 per node, but a flat $300 covers any upgrade beyond 20, up to the NetBIOS limit of 254—an eye-catching offer.

Good documentation eases your way and the company provides free support via a toll line weekdays from 9:00 A.M. to 4:00 P.M. P.S.T., but only for the first 120 days. Net-Source also runs a free bulletin board.

10NET

BY M. KEITH THOMPSON Tiara Computer Systems' *10NET* is one of the oldest packages in our review, and it keeps getting better. Version 5.0 excels at printing and connects well to other networks. By using an industry-standard protocol, Server Message Block (SMB), *10NET* allows you to share resources with other SMB networks such as *LAN Manager*. At $699 for a two-node Ethernet Starter Kit, *10NET* offers strong security, special optimization features, and the *Da Vinci eMail* program. Prices for add-on kits for 8-bit, 16-bit, and MCA cards vary from $189 to $419 per node. (Sitka (510-769-9669) also sells the *10NET* software.)

We tested *10NET* in both dedicated and nondedicated server modes, and in both modes it achieved midrange performance numbers.

10NET uses all available memory well. It comes with its own expanded memory manager and works well with third-party programs. In addition, you can turn off functions such as chat to save memory. *10NET* loads its drivers into high memory. Under DOS, a client PC gives up 32K of RAM and a server uses about 69K.

TOP-NOTCH SECURITY

10NET provides top-notch security with flexible options that allow administrators to structure the network to their needs. *10NET* includes four types of security: user, file, directory, and default. User security allows the administrator to set a user's password, node log-on address, and group. File and directory security limits access to files or directories by user groups or to one specific owner. The default security acts as a catch-all for users and files without explicitly defined rules.

Tiara's program operates as easily as any product we tested. Through pull-down menus and pop-up windows, users can access all network functions. *10NET* also comes with context-sensitive hypertext-style help.

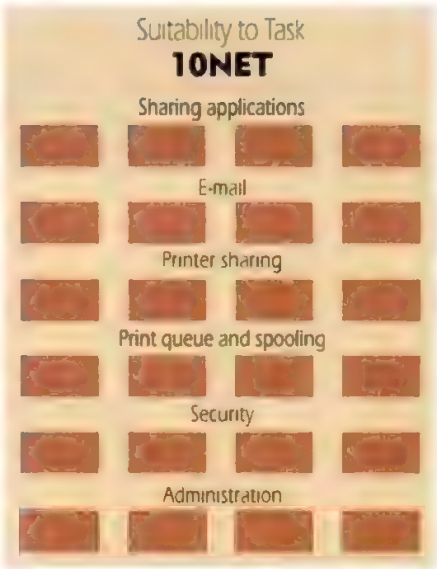
10Windows, Version 5.0, is a $249 option per LAN that will ship with *10NET* until June. *10Windows* provides full access to network resources within Microsoft Windows. *10Windows* uses three windows to control communication with other users, access to other resources, and print jobs on print servers. *10Windows* even comes with a standard Windows-based help facility.

10NET installs easily and quickly in about 10 minutes per node. The menu-driven install program asks you to select the priority of the network. Choosing "optimize for performance" sets *10NET*'s parameters to provide the fastest response time to client PCs. Otherwise, *10NET* configures your PC for maximum local performance.

The install program creates a batch file with the commands needed to load either the client redirector or server programs, along with commands to share and access devices on the network. *10NET* stores many network options in profile files, including network adapter number and high-memory use. Since these are standard ASCII files, you are able to change them with any text editor. The program's documentation explains the parameters in detail.

ADVANCED PRINTING

10NET offers the advanced print features required by many workgroups, including print-spool compression and enhanced print-queue management. Print-spool compression reduces the disk space and time needed by the network to hold and transfer print jobs. Enhanced print-queue management allows users to control print



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***10NET*, Version 5.0**
Tiara Computer Systems Inc., 1091 Shoreline Blvd., Mountain View, CA 94043, 800-638-4272, 415-965-1700.
List Price: 2-user Ethernet starter kit (with two 16-bit ISA coaxial adapters, cable, T-connectors, terminators, *10Windows*), $699
Requires: DOS 3.1 or later. Client: 30K RAM. Peer-to-peer operation: 70K RAM.
In Short: *10NET* is a full-featured DOS-based LAN with excellent remote printer support. The same software, without hardware, is sold for $299 (for three nodes) by Sitka.

CIRCLE 519 ON READER SERVICE CARD

jobs destined for remote printers on the network.

Other robust printing features include notification of completed print jobs, multiple queues assigned to one printer, multiple queues assigned to a group of printers, and support for downloadable fonts. These features give network administrators tremendous flexibility in solving printing dilemmas.

Hyperprinting is also offered. Hyperprinting allows the printer to begin printing a file even as the file spools into a queue. This is useful for very long files.

10NET also comes with a top-notch e-mail program, *Da Vinci eMail*, Version 1.8. *The Da Vinci* package allows up to eight users on the network to exchange messages and files. Simple pull-down menus and pop-up windows provide such features as receipt notification, forwarding, and phone books. *Da Vinci eMail* sets *10NET* apart from the competition.

The *10NET* packaging scheme offers flexibility and convenience when purchasing your network. Tiara sells starter kits for ARCnet and Ethernet, with and without Windows software.

Even though its product is easy to use, Tiara Computer Systems provides above-average customer support, with free phone support over a toll-free number from 8:00 A.M. to 8:00 P.M. E.S.T. Tiara's 2,400-bps and 9,600-bps BBS also handles support questions. ■

by
Joe Salemi

Advisor

FLAT-FILE DATABASES

My company has outgrown *Microsoft Works*. It was easy to find a replacement word processor and spreadsheet, but we have not been able to find a suitable replacement database. Are there any flat-file databases that allow either multiline records or multiline fields within a record? *Microsoft Works* allows a multiline field in Form View but insists on spreading the fields out into a one-line record in List View and in its printed reports. Even using a compressed font on a wide carriage printer doesn't give us enough room for one-line fields.

William D. Kraengel, Jr.
Valley Stream, New York

PC MAGAZINE Sticking to flat-file databases severely limits your choices, as well as the functionality you can expect. While they are not strictly flat-file, a number of database packages that are as easy to use as the flat-file ones provide either multiline character fields or memo-type fields that can be formatted to print on multiple lines in a report. *Q&A* 4.0 (Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-253-9600; $399), which can directly read *dBASE* files as well as its proprietary file format, has excellent report-writing capabilities. It also includes a full-featured word processor that makes it easy to create form letters and mailing labels.

Another easy-to-use package that has a full-screen report generator and support for multiline comment/text fields (up to 4K each) is *Personal R:BASE* (Microrim, 15395 30th Pl. SE, Bellevue, WA 98007; 800-248-2001, 206-649-9500; $99). *Personal R:BASE* shares the same file format as its bigger brother, *R:BASE*, and can also directly read *dBASE* files. It includes a powerful applications generator that simplifies repetitive tasks.

Both *Alpha Four* 2.0 (Alpha Software Corp., One North Ave., Burlington, MA 01803; 800-451-1018, 617-229-2924; $549) and *PC-File* 6.0 (ButtonWare Inc., 325 118th Ave. SE, #200, Bellevue, WA 98005; 800-528-8866, 206-454-0479; $149) support *dBASE*'s .DBF format, which includes large memo-type fields as their native file format. Both products include a full-screen report generator that can handle multiline text fields. *PC-File* includes a keystroke macro facility that lets you design simple applications; *Alpha Four* 2.0 has a full scripting language that supports sophisticated applications with pop-up menus.

You can get more information on these and other nonprogrammable databases in the feature story, "Database Power Without the Programming," which appeared in the December 17, 1991, issue of *PC Magazine*.

- FLAT-FILE DATABASES: Database packages that support multiline text fields in reports.
- PROTOTYPING SOFTWARE: Better tools for prototyping your applications before coding begins.

PROTOTYPING SOFTWARE

We have been developing tutorials for some time using *DEMO II* from Sage Software, but we find its limited procedural language rather cumbersome and time-consuming to use. Can you suggest a better choice?

Marc Linenberger
Shady Side, Maryland

PC MAGAZINE A number of demonstration, prototyping, and tutorial creation packages compete with *DEMO II*. *SoftDemo* (BottleWorks Development Corp., 333 Hempstead Ave., #213, Malverne, NY 11565; 516-596-9700; $149) lets you capture application screens or create them with its internal editor. It has a number of special effects including wipes, curtains, and fades. Another package that lets you capture screens or create your own is *Instant Replay Professional* (Instant Replay Corp., 4525 S. Wasatch Blvd., #335, Salt Lake City, UT 84124; 800-388-8086, 801-272-0671; $795). It also lets you prototype background music for your demos.

The Stirling Group (172 Old Mill Dr., Schaumburg, IL 60193; 708-307-9197) has two GUI-based packages: *DemoShield* ($595) for prototyping OS/2 Presentation Manager applications, and *DemoShield for Windows* ($495) for Windows 3.0 applications. Both versions support various graphics formats, such as PCX and bitmaps, and can import slides and images from drawing packages such as *CorelDRAW* and *PC Paint*.

Instant Prototyper for OS/2 and *Instant Prototyper for Windows* (WinSoft, 10 Coleman Pl., #3, Menlo Park, CA 94025; 415-324-9552; $395 and $99, respectively) also create GUI-based demos and prototypes. Both versions support animated demos, with buttons, menus, and linked windows.

By the way, *DEMO II* is now known as Dan Bricklin's *DEMO II* and is sold and supported by Lifeboat Software Corp. (1163 Shrewsbury Ave., Shrewsbury, NJ 07702; 800-447-1955, 908-389-0037). The current version is 3.0, and the price ranges from $249 to $995, depending on the options you choose. Owners of previous versions can upgrade for $125 or get the professional version for $495.

ASK THE ADVISOR

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6 PCs or Printers/Any Combination

Practicality *LC – 256Kb* $395

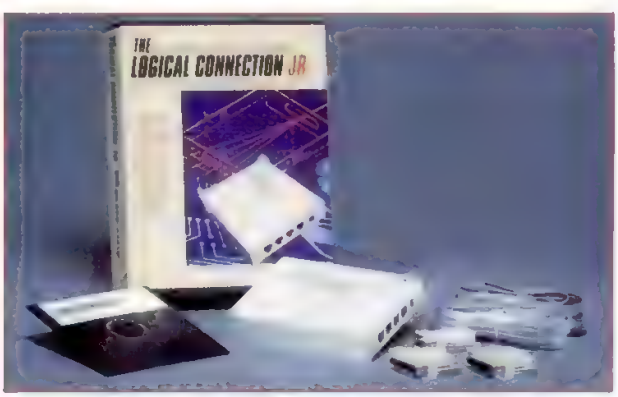
The original Logical Connection is still all the printer sharing device that most people need. The LC is ideal for printing of word processing and occasional graphics data. Its eight ports are: four bi-directional serial ports which can be set as input or output, two parallel inputs and two parallel outputs. Six users can share two parallel printers. The serial ports can also share modems.

6 PCs to 2 Printers (Typical)

Simplicity *LC Jr. – 256Kb* $239

Inexpensive modular cable, even hundreds of feet in length, can be used to serially connect up to four PCs to the Logical Connection Jr. at speeds up to 115,200 bps. Plug your existing parallel printer cable into the LC Jr. and it will automatically convert the data from serial to parallel for fast parallel printing. Multiple users can send data simultaneously since the memory will buffer and queue jobs on a first-in-first-out basis.

4 PCs to 1 Printer



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CIRCLE 131 ON READER SERVICE CARD

by
Jeff Prosise

Tutor

COMPUTER TERMS: PART 1

Hardly a month goes by without someone requesting a glossary of computer terms to help in deciphering the various trade papers. This Tutor column—the first of two—explains some of the vocabulary related to systems in general and microprocessors more specifically. In the next installment, we'll look at disk drives. While this only scratches the surface, it's a good place to start learning the language of personal computers.

SYSTEMS

A computer's **BIOS (Basic Input/Output System)** is a set of routines that—in response to requests from the *operating system* or individual applications—provides primitive control of the computer's devices such as video adapters, printers, and disk drives. Stored in read-only memory (ROM) within the machine, these instructions form a permanent part of the computer. The three most common BIOSes found in PCs and compatibles (other than those from IBM, Compaq, and some of the larger system manufacturers who write their own) come from AMI, Award, and Phoenix Technologies.

A **bus** is a collection of electrically conductive paths shared by chips on the system board, the processor, and the cards in the computer's expansion slots. Devices attached to the bus get power from some of its lines and communicate among themselves or others by exchanging electrical signals. A typical bus carries three types of signals: *timing* and *control*, *data*, and *address*. Timing and control signals allow operations to occur in the proper sequence and also inform devices about the type of process taking place (or pending). Data is the information passed between devices—from random access memory (RAM) to the microprocessor, for example. Addresses identify either the memory location or the I/O port involved in a data transfer.

CPU (central processing unit) See *microprocessor*.

COMPUTER TERMS: PART 1: The first in a two-part series defining common industry terms. This column covers general systems and microprocessors.

Device drivers are programs linked to the operating system at start-up, which contain the information needed to handle a *peripheral* (attached piece of equipment, such as a hard disk). These drivers extend the operating system's control abilities to include devices it would not normally recognize. Two kinds exist: system and installable. System drivers are built into DOS. You can see their names by typing MEM /D at the command line and looking at the first listing for IO in the Name column. Installable drivers are loaded with the DEVICE= command in CONFIG.SYS. Under DOS 5.0, they can also be loaded with the DEVICEHIGH= statement. A few of the installable device drivers that are included with DOS 5.0 are SMARTDRV.SYS, RAMDRIVE.SYS, HIMEM.SYS, and ANSI.SYS.

A **DMA (direct memory access) controller** is system board circuitry that allows devices in your PC (such as disk controllers, which transfer information between the hard disk and the *CPU* or memory) to transmit data to and from memory with no CPU involvement, hence the term *direct* memory access. Your PC contains at least one DMA controller to aid the rapid transfer of data to and from memory. Some popular hard disk backup programs use DMA to increase *throughput* (the amount of data flowing).

Microsoft's **DOS (Disk Operating System)** ranks as the most popular control program for IBM personal computers and compatibles. The company calls its product MS-DOS. Other vendors license the package for resale with their systems, giving it another name such as PC-DOS in the case of IBM. Microsoft's most recent DOS version, MS-DOS 5.0, offers several features not found in previous releases, including utilities for unformatting disks and recovering erased files; it also uses RAM more efficiently. See also *operating system*.

EISA (Extended Industry Standard Architecture) refers to the *32-bit* bus architecture pioneered by Compaq and a consortium of PC vendors. (32-bit refers to the 32 data lines the bus contains, each capable of carrying the signal for a 1 or a 0—one binary digit or *bit*.) EISA extends the 16-bit *ISA* design featured in the AT. Although other factors affect performance, doubling the width of the data path roughly doubles the amount of information transferred on the bus in a given period.

EISA competes directly with IBM's proprietary 32-bit *Micro Channel* architecture, introduced with the PS/2 family of machines in 1987. One significant difference between the two is that the EISA bus accepts *ISA* cards—Micro Channel machines will not. See also *ISA* and *Micro Channel*.

An **interrupt** is a mechanism for stopping the instruction sequence that is currently running and transferring control to another instruction sequence called an *interrupt service routine* (ISR). The ISR is written to handle properly whatever caused the break in normal program flow and then return control to the original routine. There are three types of interrupts in a PC or compatible: software interrupts, hardware interrupts, and exceptions. A *software interrupt* is triggered when a program executes an INT instruction—usually to call a routine in *DOS* or the *BIOS*. A *hardware interrupt* occurs when a device external to the CPU—such as a keyboard or serial port—signals the microprocessor (via the *interrupt controller*) that it needs atten-

tion. An *exception* is generated by the microprocessor itself if it encounters an error condition—a program attempting to divide by 0, for example. See also *interrupt controller.*

An **interrupt controller** is a chip that receives and prioritizes hardware interrupts before passing them to the *CPU.* The microprocessor in a PC or compatible has just one interrupt line, so it can service only a single interrupt at a time. Interrupt requests, however, may come from several devices simultaneously or within a short time of each other. The interrupt controller features eight *interrupt request* lines (IRQs), allowing it to take in multiple requests and pass them one at a time to the processor, ensuring that each device gets its turn. PCs contain at least one interrupt controller. See also *interrupt* and *IRQ line.*

An **I/O (Input/Output) port** is a special location accessed—like individual locations in memory—via an address, which serves as an *interface* (connection) between the *CPU* and an external device. For example, to read a key code from the keyboard controller when a key is pressed or released, the CPU takes in a byte value from I/O port 60h (address 60, counting in hexadecimal). I/O ports are accessed with special CPU instructions such as IN (read a value into the processor from an I/O port) and OUT (write a value from the CPU to an I/O port).

An **IRQ (interrupt request) line** is the *trace* (a narrow copper path printed on a circuit board) that carries electrical signals between a device installed in your PC and the *interrupt controller.* The IBM PC and XT have eight IRQ lines, numbered 0 through 7. IRQ0 and IRQ1 are reserved for the periodic *memory refresh* (the frequent rewriting most RAM requires to maintain its contents) and keyboard, respectively. The AT and compatibles have 16 IRQ lines. When you install an *interrupt-driven* device (one that issues interrupts when it needs attention) such as a serial port, you must assign it an IRQ line not already in use by something else. Devices you add to your computer generally have a controller (also called an adapter) card that fits into a bus expansion slot. On some PCs, you can assign IRQ settings to individual cards using software supplied for that purpose. Typically, though, you must place *jumpers* (small electrical connectors) on appropriate pins located on the card or change tiny *DIP* (dual in-line package) *switches*—so called because of the double row of electrical contact legs stuck into the epoxy case or *package* that contains the switches.

ISA (Industry Standard Architecture) refers to the 16-bit bus standard popularized by the IBM AT. The majority of PCs that are sold today come with an ISA bus, although 386 and 486 PCs typically feature nonstandard slots that provide a 32-bit path—but only between the microprocessor and the installed memory. Other expansion slots and chips unrelated to memory functions do not share the special memory bus. Two solutions to the problem of nonstandard 32-bit slots are *EISA* and *Micro Channel* architecture; each one of these provides a different standard for a 32-bit bus. See also *EISA* and *Micro Channel.*

> The microprocessor combines the functions of an instruction execution unit, a bus interface for communicating with memory and I/O ports, and other elements for distributing the work among components.

Math coprocessors are units designed to perform *floating-point* math calculations quickly and with a high degree of precision. (Floating-point is a method used to represent numbers—similar to scientific notation—in which the position of the decimal point can vary or *float.*) Normal CPUs contain far less-sophisticated math instructions, so software must direct them through many primitive calculations to achieve the same result. The 486DX microprocessor has a math coprocessor built in, but others in the family require the addition of a coprocessor in the form of a companion chip or circuit board. A math coprocessor can have a profound performance impact on programs written to take advantage of floating-point hardware; however, it will have absolutely no effect on programs that don't support it. See also *80x87.*

The 32-bit bus standard engineered by IBM and featured in most of its PS/2 machines is called **Micro Channel** architecture. Micro Channel PCs require boards designed to fit the Micro Channel bus. Micro Channel is also known by the name Micro Channel architecture (MCA). See also *ISA* and *EISA.*

The brains of your PC, the **microprocessor** is typically a highly *integrated* chip. It combines the functions of an instruction execution unit, a bus interface for communicating with memory and I/O ports and—often—other specialized elements for distributing the work among several components. The most common microprocessor chips in PCs are the members of Intel's *80x86* line. Microprocessors are sometimes called CPUs, or *central processing units.* The microprocessor doesn't do all the work by itself; it's aided by various support chips such as *interrupt* and *DMA* controllers. See also *80x86.*

The **operating system (OS)** is the software that drives your PC. The operating system acts on instructions you type at the command line once the *command interpreter* (COMMAND.COM, for DOS) has read and translated them. Services provided to application programs allow high-level tasks such as reading and writing disk files, *allocating* (reserving) memory, and *deallocating* (freeing) it. The operating system you're probably most familiar with is *DOS.* Others that are well-known include OS/2, Unix, VMS, and the Macintosh OS.

The **POST (power-on self-test)** is the set of diagnostic routines your PC executes every time it is turned on to ensure the integrity of its components. The POST makes sure all chips on the system board function and it initializes hardware devices attached to your PC. See the February 13, 1990, Tutor column for a detailed description.

MICROPROCESSORS

CISC (complex instruction-set computing) refers to microprocessors such as those in the *80x86* family that understand dozens or perhaps hundreds of different instructions. The method used to perform multiplies points out one difference be-

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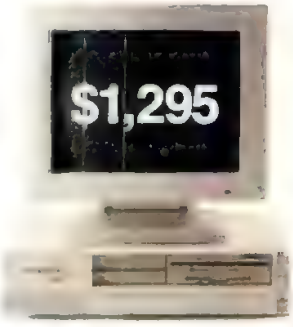

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tween some CISC and RISC processors. Most CISC chips contain a multiply instruction (MUL or IMUL on the *80x86*), but a RISC may not. To multiply two numbers on a RISC, you'd write your own multiplication *algorithm* (solution method) that would do the job by relying on repeated adds. See also *RISC*.

Clock speed is the frequency, expressed in *MHz* (*megahertz* or millions of cycles per second), of the clock crystal that initiates every step of a *CPU* instruction cycle. The processor uses pulses from the clock to synchronize itself internally and with the chips and devices it is attached to. Clock speed for the *80x86* microprocessor family ranges from 4.77 MHz for the 8086/8088 to 50 MHz for the latest 80486. In general, clock speed sets the upper boundary on how fast the computer runs. Other factors, such as the CPU's internal architecture, how quickly processor support chips and the bus transfer information, and the time required to access memory, may slow a computer, but they can't raise its performance above the limit set by the clock.

80x86 is the generic term used to refer to members of the Intel microprocessor family used in IBM PCs and compatibles. It includes the 8086, 80286, 80386 (SX and DX), and the 80486 (SX and DX), as well as the 8088. (The 8088 is identical to the 8086 except that the 8088 has an 8-bit rather than a 16-bit external interface. In other words, the 8088 attaches to an 8-line data bus.) The 80x86 family also includes the nearly forgotten 80186 and 80188 chips. These were not used for personal computers; they were primarily used as *embedded controllers* (CPUs that run computers meant for limited and specialized tasks such as supervising automated machining equipment). See also *microprocessor*.

80x87 is the name given to Intel's family of math coprocessors: the 8087 (for 8086s and 8088s), the 80287 (connects to 80286 machines), the 80387 (supplements 80386s), the 80387SX (for the 80386SX) and the 80487SX (which assists 80486SX CPUs). Some of the early 386-based PCs used 287 math coprocessors since the 387 wasn't yet available. See also *math coprocessor*.

The **instruction set** is the group of commands a microprocessor recognizes, each of which cause it to perform a specific action—moving a byte of data from one register to another or calling an interrupt, for example. A microprocessor may understand anywhere from a handful of instructions to several hundred, depending on its design.

However, computers can interpret only 1s and 0s—and those must be presented in electrical form as a high or low voltage. Programmers, therefore, use *assembly language*, which assigns unique *mnemonics* (names used as memory aids) to each numerically encoded instruction. A program known as an *assembler* converts the mnemonics back to *machine language* (the 1s and the 0s that the processor can read). A typical *80x86* assembly language instruction is MOV AH,33h, which instructs the microprocessor to transfer the value 33 hex into the AH *register*. See also *RISC* and *register*.

> The 80486 takes the pipelining technique to new heights, executing most instructions in a single clock cycle and accounting in part for its superior performance compared with earlier Intel CPUs.

Pipelining means *fetching* (retrieving from memory) and decoding of the next instruction to be processed while the previous one is executing. This increases performance over older methods, which wait to get and translate each instruction until the current one completes. Separate units built into the microprocessor for fetch, decode, and execution make pipelining possible. The 80486 takes the technique to new heights, executing most instructions in a single clock cycle and accounting in part for its superior performance compared with earlier Intel CPUs.

Protected mode indicates an operating state that permits 80286, 80386, and 80486 microprocessors to access memory beyond the 1MB *real mode* boundary. In protected mode, an 80286 can reach up to 16MB of RAM; an 80386 or 80486 microprocessor, up to 4 gigabytes. The name derives from the ability of the CPU, when running in protected mode, to isolate executing programs from each other. This allows *multitasking* (multiple routines sharing the processor's time and the computer's memory space) while preventing an errant application from affecting any other program—especially the *operating system*. Protected-mode operating systems such as OS/2 also have the option of implementing *virtual memory*, which lets other system resources such as hard disk space stand in for physical memory. See also *real mode* and *Virtual 86 mode*.

Real mode is the only operating state available with the 8086 and 8088, and the one in which 80286s, 80386s, and 80486s must run in order to emulate an 8086. In real mode, the microprocessor is able to address just 1MB of memory, no matter how much RAM the system may contain. (There are exceptions: an 80286, 80386, or 80486 running in real mode can acquire limited access to RAM above the 1MB mark by relying on undocumented processor instructions or manually manipulating address lines.) See also *protected mode* and *Virtual 86 mode*.

A **register** is a storage location inside a microprocessor for temporarily holding data. The 8086 has 14 registers, each one 16 bits in length. Other members of the *80x86* family have more. Many of the 80386/80486 registers are a full 32 bits in length. When possible, programmers keep values in registers because access to data is far faster than retrieval from or storage to memory. Some registers can be used for general data storage, while others are reserved for specific uses.

RISC (reduced instruction-set computing) is the term for microprocessors that rely on a small set of basic instructions. Complex operations such as division and multiplication that may be performed with a single instruction on a *CISC* chip must be implemented as a series of instructions on a RISC microprocessor. The advantage is that the smaller instruction set allows the microprocessor to decode and execute the instructions much faster, so several RISC instructions may take less time to execute than a single CISC instruction.

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Stepping levels for microprocessor chips are like version numbers for software. The 80386 went through several stepping levels on its way to maturation, correcting a few bugs along the way—some innocuous, others not. For example, some of the early 80386s (A-step chips) could not be switched from protected mode back to real mode. Later 80386s contained bugs that could cause random lockups and multiplication errors, as well as some other glitches. The February 11, 1992, Tutor column contained the listing for a short program called 386STEP. This program is able to identify B0-step chips and earlier as well as B1-step and D0-step 80386 chips and later.

Virtual 86 mode is available only on 80386 and 80486 microprocessors. This operating state allows one CPU to emulate multiple 8086 computers. In essence, your computer can be several 8086s running at once. Hence, it also allows *real-mode* programs to be executed in a *protected-mode* environment.

One practical implication of this is that protected-mode operating systems such as OS/2 and *operating environments* (programs that look like an operating system but really use an underlying one to perform system duties—Microsoft Windows, for example) can use Virtual 86 mode to multitask DOS applications. 80386 memory managers such as *QEMM-386, 386MAX*, and DOS 5.0's EMM386 .EXE run DOS in Virtual 86 mode so that they can use the paging (memory mapping) capabilities of the 80386 and 80486 to make *extended memory* (storage above 1MB) appear to be in unused regions of upper memory (memory locations between 640K and 1MB), creating pockets of usable RAM called upper memory blocks, or UMBs. See also *protected mode* and *real mode*.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. Send your question to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 10 for instructions). We regret that we can't acknowledge submissions or answer questions individually. ■

by
Neil J. Rubenking

User-to-User

COPYING FILES SAFELY

One of the most difficult mistakes to recover from is inadvertently overwriting a desired version of a file with an undesired version when using the COPY command. The chances of this happening are reduced if the user is asked for confirmation before COPY overwrites a file. Michael J. Mefford's COPYSAFE utility (Utilities, March 31, 1987) does just this. Users of DOS 3.3 or later can also copy files more safely by using this batch file:

```
REPLACE %1 %2 1p
REPLACE %1 %2 1a
```

The first line of the batch file prompts you if COPY would have overwritten a file: that is, if the source filename matches one in the destination directory. However, this line does nothing if there's no match. In that case, the second line copies the source file to the target directory. The result is that if COPY would not have overwritten a file, then copying takes place with no prompting. The batch file reports whether the file was replaced, added, or if neither happened.

DOS wildcards work with this batch file, and since it's not a TSR, there's no possibility of conflicts with other TSRs.

Gabriel A. Lozada
Bryan, Texas

There are many utilities to help you get back a file that you've deleted. But once you've overwritten the file, it's almost impossible to retrieve it. At best, if the actual data clusters of the file were not overwritten, the process involves laboriously rebuilding the connection between the file's directory entry and its first data cluster. If the clusters containing the data *were* overwritten, only specialized equipment has even a chance of retrieving the file.

Be careful when copying files into a directory that isn't empty. If you make a habit of using the simple COPYSAFE .BAT utility, you'll never overwrite a file in the destination directory without choosing to do so. You'll still need to use the COPY command if you want to copy a file to a file of a different name, or to concatenate files, of course.

- COPYING FILES SAFELY: A handy little batch file keeps you from accidentally overwriting valuable data.
- USING SETVER: DOS 5.0's new SETVER command is very useful—but it can't solve all your problems.

USING SETVER

I have a directory-sorting program that I used under DOS 3.3, and I really like it. But when I moved to DOS 5.0, the program stopped working correctly. I tried using SETVER to set the version back to 3.3, but that didn't help. What can I do?

Ming Steineau
San Francisco, California

When you try to run a DOS program like RESTORE or CHKDSK under a different DOS version, it halts with an "Incorrect DOS version" error message. Sometimes that's a valid message, other times it simply reflects caution on the part of the program's designer. We've frequently printed instructions here for patching such programs to avoid the DOS version check, but we won't have to do that anymore. DOS 5.0's SETVER command makes patching out the version check obsolete.

SETVER has a split personality. As a device driver, it sits in memory watching for programs that check the DOS version. As an executable program, SETVER reports the list of programs it's watching out for, and lets you edit that list. Whenever one of the listed programs calls the DOS function that returns the current DOS version, SETVER intercepts the call and returns the value that program wants to see. In effect, it lies to the program!

Many enthusiastic DOS 5.0 users view SETVER as a cure-all. If a program fails mysteriously, they immediately suggest SETVER. But in truth, the only time SETVER is useful is when a program *incorrectly* refuses to run under DOS 5.0. Here are the four possibilities you may encounter when running a program under DOS 5.0:

- Incompatible—won't run. SETVER can't help.
- Incompatible but tries to run. SETVER can't help.
- Compatible but won't run. Use SETVER.
- Compatible—runs. No problem.

The only programs SETVER can help are those in the third category, the ones that have no compatibility problems with DOS 5.0 but refuse to run. It sounds as if your directory-sorting program was in the second: It was not compatible with DOS 5.0, but tried to run anyway.

DOS 5.0's INSTALL program places SETVER in your CONFIG.SYS files, so SETVER is probably active on your system. Type SETVER with no parameters at the DOS command line to see SETVER's program list. You may need to pipe the output through the MORE command to keep it from scrolling away too fast. If you don't use any of the programs on the list, you can safely remove SETVER from your CONFIG.SYS and save a few hundred bytes of RAM.

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CIRCLE 183 ON READER SERVICE CARD

by
Fran Finnegan

Windows

TO SUBST OR NOT TO SUBST

In the December 31, 1991, Windows column, you published a tip concerning the use of the DOS SUBST command to shorten command lines such as the environment PATH under Windows 3.0. In the README.TXT file provided with both Windows 3.0 and 3.0a, in a section titled "Omit the APPEND, JOIN, and SUBST MS-DOS Utilities," a warning is given about using these utilities under Windows. A cursory reading of this README section might lead you to believe that the warning applies only to DOS sessions started under Windows, but not to the base DOS session in effect before invoking Windows. Not true! As I discovered under DOS 5.0, several common Windows programs, for example, WINFILE .EXE (File Manager), SYSEDIT.EXE (System Configuration Editor), and Bitstream's *FaceLift*, all encounter problems with SUBST under DOS 5.0.

To see the problems for yourself, enter the following at the DOS prompt when starting Windows:

```
subst w: c:\windows
w:
win
```

This SUBSTitutes W: to refer to your main Windows directory. After Windows starts from the W: drive, run SYSEDIT. It will state that it is unable to load the files W:\\SYSTEM.INI and W:\\WIN.INI. (The two backslashes are correct.) Similar problems crop up inconsistently with WINFILE, but not, however, with the retrograde MSDOS.EXE (MS-DOS Executive).

Some unfortunate users have defined W: (via SUBST) to be their Windows directory, and then installed Windows onto the W: drive. Various font programs (*Adobe Type Manager*, *FaceLift*, and *Intellifont*), along with their font installers, can't cope with this. WIN.INI becomes filled with double backslashes, as do certain control files associated with Bitstream's *Facelift*. As a consequence, you have to reload *FaceLift* and clean up WIN.INI. And you must be prepared to run CHKDSK or disk/file-recovery software as you may corrupt your disk's file allocation table (FAT).

> ■ TO SUBST OR NOT TO SUBST: What risks do Windows users take in substituting directories for drives with the DOS SUBST command?

What is even more interesting is that these problems disappear if the base operating system is either DR DOS 5.0 or 6.0. Here is a case where the two operating system varieties are incompatible, but in this case Digital Research's DOS appears to be more compatible with Windows software than is Microsoft's DOS.

When I approached a DOS 5.0 engineer at Windows Discovery Days shortly after the DOS 5.0 release and complained about the problems I was having with the SUBST command, he was the one who pointed me to the README.TXT file. He said that the warning had been in there since Windows 2.0, and that, if I persisted in using the offending command, I risked trashing my hard disk, because of the way Windows caches directory entries internally. He was unable to respond to my question that, if the warning was *so* serious, why wasn't it either fixed in DOS 5.0 or migrated to the Windows user guide, which is read by a much larger audience than README.TXT?

Doug Campbell
Culver City, California

PC MAGAZINE SUBST is fully documented in MS-DOS's *User's Guide and Reference*, so I won't detail it here. It basically permits you to SUBSTitute a drive letter for a directory on your disk. This allows you to refer to an often-used directory quickly, easily, and economically. It's a great feature, which Microsoft copied from other operating systems. You can use any drive letter up to the LASTDRIVE= letter indicated in your CONFIG.SYS file (if you include such an entry), or up to E: if you don't include this entry (provided that you don't have physical drives up to E:).

If you haven't read your Windows README.TXT file, the relevant section states: "The MS-DOS utilities APPEND, JOIN, and SUBST can cause problems when you are running Windows 3.0. If you included APPEND, JOIN, or SUBST in your AUTOEXEC.BAT file, remove them and refrain from running them within Windows." I personally have never used APPEND or JOIN, so I won't comment on them here, but I *have* been using SUBST from Windows 1.01 through Windows 3.1 beta 3 with a lot of success and never a problem. The trick is to understand why SUBST can cause problems so that you can indeed use it safely.

Microsoft treats the SUBST command the way it does the DOS CHKDSK command. It simply says don't use them, without qualifying that statement. In fact, Windows 3.1's Setup now detects when SUBST is in effect, and even warns you to get rid of it, making you override the warning if you want to continue. However, just as it is possible to use CHKDSK in Windows, as long as you don't use the /F (fix) parameter with it, you can also safely use SUBST. There are two things that you have to understand, but they are things you need to understand to use it correctly under DOS, as well. First, you do not want to alter the underlying disk directory and file structure that Windows, applications, and DOS shells are sitting on top of, or else they may become "confused." Second, some programs (even if they are part of Windows) can't deal with files in the root directory of a drive, including SUBSTituted drives.

To illustrate the first point, let's say you had SUBSTituted X: in your AUTOEXEC.BAT file to be the "drive"

where you keep all of your *Excel* data files, and that *Excel* is running with a file named X:\FINANCES.XLS open. Now go to a DOS shell and enter the command:

```
SUBST X: /D
```

which deletes the SUBSTituted virtual drive X:. *Excel*, SHARE (if it is loaded), FASTOPEN (if it is loaded), and possibly other parts of DOS will have some real problems with this, since X: no longer exists as a "drive." If you then re-SUBSTitute X: for another directory, things will *really* get confused. You will have essentially taken a drive out from under Windows and/or an application while that drive is in use. Using SUBST this way can cause considerable damage to your directory and file structure.

What about the initial-double-backslash problems? These aren't really either DOS or Windows problems, but are the result of applications (including Windows' Setup) that are not coded to handle files in root directories properly. Applications are used to asking the operating system for the current working directory of a drive. For example, Windows (really DOS) might return C:\WINDOWS to an application. To this, the application (such as SYSEDIT) might append a filename, such as \WIN.INI. The resulting file specification would be C:\WINDOWS \WIN.INI. Fine and good. But what happens when the current working directory is the root directory, such as W:? The operating system would return W:\, which ends in a backslash to signify the root directory. When the \WIN.INI is subsequently appended to this, you get W:\\WIN.INI—which is obviously wrong. Applications *should* check to see if they are running at the root directory when they create filenames, but they don't all do this.

This is not an operating system problem. However, it's a sad situation when many applications, including the File Manager and SYSEDIT, leave out a mere two lines of code that could easily check for and correct this problem. For example, the IF statement in the following C code is all that is necessary to correct the problem in SYSEDIT when it goes to create the WIN.INI file specification:

```
getcwd(szDir, sizeof(szDir));
if (szDir[3] == '\0')
    szDir[2]  = '\0';
strcat(szDir, "\\WIN.INI");
```

This C code gets the current working directory; checks the fourth character to see whether it's null, which would imply a root directory; if it is the root, the code removes the third character (the backslash); and then appends the \filename to create the file specification. Simple. (Are you paying attention, Microsoft?)

If you have an application that has trouble with files at the root directory of a "drive," all you can do is change your SUBSTitutions so that the files are no longer at the root. For example, consider shortening something like this

```
SUBST P: C:\WINDOWS\SYSTEM\PIF
```

to this

```
SUBST P: C:\WINDOWS\SYSTEM
```

and then lengthening the reference to a hypothetical file therein from this

```
P:\FILENAME.PIF
```

to this

```
P:\PIF\FILENAME.PIF
```

Even though the file is on a SUBSTituted drive, it is no longer at the root of that drive, so you shouldn't have the initial-double-backslash problem in addressing the file.

In summary, if you follow these guidelines, you should be able to use SUBST safely and correctly:

- Don't install Windows on a SUBSTituted drive, no matter what.
- Beware that the Windows Setup program has problems with SUBSTituted drives *when it initially installs Windows*, so it is best not to have any in effect when you first install Windows. The problems mostly occur when Setup scans all your drives, looking for applications to install in Program Manager. I've never had a problem while SUBSTituted drives were in effect when subsequently running Setup from *within* Windows.
- Once Windows is installed, SUBST should be used to set up your desired disk structure *before* Windows is run, preferably in your AUTOEXEC.BAT file.
- Do not point your TEMP= environment variable or any other "temporary" file variable to a drive letter alone, whether or not it is a SUBSTituted drive. For example, I use my RAM drives (created with RAMDRIVE.SYS) for TEMP storage. Depending on which machine I'm on, the RAM drive letters will vary, so I make the following SUBSTitution (where D:\is the RAM drive root, and the precise "drive" letter depends on the number of physical drives and partitions on a particular machine):

```
MD D:\TMP
SUBST R: D:\
SUBST T: D:\TMP
SET TEMP=D:\TMP
```

I can then use R: across all of my machines to refer to my RAM drives, and T: to refer to my "temporary" file drives. But the TEMP variable still points to the actual pre-SUBST location, which is the same location as specified in the SUBST command. (While it would be permissible to have TEMP point to T:\, TEMP will be ignored if it simply points to T: (without the backslash); this isn't documented anywhere that I know of.)

- Don't delete or change a SUBSTitution while within Windows, or else an open file may get wiped out, or your FAT may get damaged. But if you really know what you're doing (that is, if you know which files are open and, therefore, which drives should not be changed), you can do this. If you're at all unsure, don't do it.
- Adding a new SUBSTitution using an unused "drive" letter within Windows works fine. I've had no problems doing this.

If you're very conservative, you can follow Microsoft's advice; however, by just being careful, you can enjoy the tremendous benefits of SUBST.

Remember, too, that certain applications that do not know how to properly create root-directory file specifications will have trouble with SUBSTituted drives (the initial-double-backslash problem), whether they are running under MS-DOS or Windows.

OPENING WINDOWS

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by
M. David Stone

The Working Word

DROP CAPS

Drop caps—the technique of starting a new section of text with a large font size for the first character—can give a polished, professional look to your documents. You can create drop caps in *Microsoft Word for Windows* 1.1 by importing the drop cap character as a graphic.

After writing the text of your document, go to any graphics program that produces a graphics file format accepted by *WinWord,* and create a file that consists only of the single, large letter you need for the drop cap. Next, go back to *WinWord,* delete the normal-size letter you want to replace with a drop cap, and press Enter to create a new paragraph above the text. With the cursor in the new paragraph, choose Format Position, and format the paragraph with a horizontal position of Left relative to Margin, and 0 distance from text. (The default horizontal position setting is Left relative to Column, which is how the remaining text should be formatted so that it will wrap around the drop cap. Leave the Vertical Position at the default setting of Inline relative to Margin.)

With the cursor still in the paragraph you've just formatted, use the Insert Picture command to paste the graphics character into the document. Make sure the View Field Codes option is toggled off, or you will see the field code rather than the graphic. Also be sure to be in Page View. Then use the graphic's sizing handles and *WinWord*'s standard graphics commands to manipulate the picture size, shape, and position to suit your taste. When you're done, the drop cap will print along with the rest of the text.

Steve Sciallo
Santa Barbara, California

PC MAGAZINE The process of creating drop caps has as many variations as sharks have teeth. The most important variation is between drop caps created as graphics and those created as text.

The chief advantage of using an imported graphics image for the drop cap is

- DROP CAPS: How to produce drop caps in *Word for Windows* 1.1 and 2.0, using graphics, text, and WordArt.

that it will work with any printer that can print graphics on the same page as text. In addition, if you're using *WinWord* or any other Windows-based word processor, then you have at least one graphics program available—Paintbrush—to create the drop cap. The disadvantage is that with most graphics programs, anything other than horizontal or vertical lines in the drop cap image will typically show aliasing, yielding a distinct, saw-tooth effect that will take away from the professional look, as Figure 1 shows.

Drop caps created as text have exactly the opposite advantages and disadvantages. The chief advantage of a text-based drop cap is that it will show the same smooth edges as any other text produced by the same printer. The chief disadvantage is that there may not be a large enough font available to your printer.

Font size won't be an issue for PostScript printers, the Hewlett-Packard LaserJet III (and other PCL 5 printers), or other printers that use scalable fonts, which can be scaled to any desired size. It will be an issue for printers that use bitmapped fonts, such as the LaserJet Series II. (Note that under *WinWord* you can generate large fonts with dot matrix printers. However, dot matrix printers have their own limitations on print quality.)

Another level of choice is that you can use programs like *Adobe Type Manager* and Bitstream's *FaceLift* to provide scalable fonts for printers that don't normally support scalable fonts.

If you have an appropriately large font available, either bitmapped or scalable, and you are using *WinWord,* Version 1.1, you are generally better off using text-based drop caps. To use one in *WinWord* 1.1, put the drop cap in its own paragraph and adjust the position settings for that paragraph, just as with graphics-based drop caps.

Note that with a text-based drop cap, you'll also have to set a specific paragraph width in the Position dialog box. If you leave the setting at Auto (the default), *WinWord* will assign the full width of the text area to the single letter paragraph, so the other text won't wrap around it.

If you're using *WinWord,* Version 2.0, you'll find that setting up a drop cap requires a notably different procedure than in 1.1. First, Version 2.0 comes with a macro, called DropCap, that automates the entire procedure for you. You'll find the macro in the file NEWMACRO.DOC. *WinWord*'s installation program should have placed this file in the *WinWord* program directory when you installed the program (assuming you used the complete installation option).

To use the DropCap macro, you'll first

Drop caps are a typographical technique in which you start the first p with an oversize letter. Although the term is often applied to any la a section, it's technically limited to characters that are aligned so th character is even with the very top of the first line of text. If the top of the first line of text, and the bottom of the character is aligned with the baselin

Figure 1: This ragged-looking drop cap, produced by a graphics image created in Paintbrush, is typical of characters produced by graphics programs as bitmap images.

Drop caps are a typographical technique in which you start the fi
with an oversize letter. Although the term is often applied to a
of a section, it's technically limited to characters that are align
character is even with the very top of the first line of text. If t
higher than the first line of text, and the bottom of the character is aligned

Figure 2: This drop cap, produced by the DropCap macro that comes with *WinWord* 2.0, leaves more space below the drop cap character than you would ideally want, since the gap is large enough for a full line of text.

have to copy it to the template you want to use it in. (If you're not familiar with the concept of templates, copy it to the Normal template.) To copy the macro, simply open the NEWMACRO.DOC file. *WinWord* will automatically run a macro that will show you a dialog box. Select DropCap in the list of macro names and choose the Install button.

You'll now see a second dialog box. Select the template to copy to, optionally select a menu and shortcut key to assign the macro to in that template, and choose OK to have the NEWMACRO.DOC macro automatically copy the DropCap macro to the template. (You should also experiment with the other macros in the NEWMACRO.DOC file.)

Once you've copied the DropCap macro to a template, you can use it whenever you're editing a file with that template attached. Simply place the cursor or selection anywhere in the paragraph that you want to start with a drop cap, and run the macro. The macro will automatically find the first letter of the paragraph and turn it into a drop cap, as Figure 2 shows. Unfortunately, the positioning of the drop cap could stand some improvement—a point we'll come back to. (Note in passing that the DropCap macro will automatically switch *WinWord* to page layout view, because drop caps won't show as drop caps in normal view.)

Unlike Version 1.1, in *WinWord* 2.0 there is no Format Position command. Instead, the paragraph with the drop cap letter goes in a frame, and you use the frame to set its position. To create the drop cap manually, you would add a paragraph return after the first character in a paragraph, format the character with an appropriate font size, select the entire paragraph, and choose Insert Frame.

You can then position the character in the frame, and position the frame itself. The DropCap macro formats the paragraph as Centered (choose Format Paragraph and set Alignment to Centered) and formats the character as a superscript so that the top of the character is at the top of the frame (choose Format Character, and enter the Superscript setting with an appropriate number of points to raise the character).

To adjust the frame, use the Format Frame command. A good starting point is with a horizontal setting of Left Relative to Margin, and a Vertical Position of 0 Relative to Paragraph, with Distance From Text set to 0 for both instances. Also be sure to select the Move with Text check box for Vertical Position, to be sure that the character will move with the rest of the paragraph if you edit or reformat the text.

Another difference in *WinWord* 2.0 is that it comes with its own graphics programs, which you can use to build drop caps as graphics. In particular, be sure to take a close look at the WordArt mini-application. (If you installed *WinWord* with the full installation, you will have WordArt on your disk. If not, you can install it by rerunning the install program and choosing the custom installation option.) WordArt uses object-oriented graphics, which for our purposes means it produces graphics-based drop caps that are as smooth as text-based characters.

To create a drop cap with WordArt, delete the first letter from the paragraph. Then, with the cursor at the beginning of the paragraph, choose Insert Object, and choose MS WordArt as the object type. You can then define the drop cap as a graphic in WordArt. (You'll want to experiment with the various choices for fonts and options. WordArt provides its own fonts that have nothing to do with the fonts available to Windows as text.)

When you're done defining the character, choose OK to return to the document and insert the picture. Then select the drop cap and use the Format Picture command to adjust the picture size. You'll usually want to set the height and width to be the same, and you'll want the height to run from the top of one line to the bottom of another. For example, if the body text is set for 12 points, and you want the drop cap to be three lines high, you should define the picture height and width as 38 points (12 times 3, plus 1 point added between each line).

With the drop cap still selected, choose Insert Frame to place the image in a frame, then Format Frame, if necessary, to adjust the frame size (you shouldn't need to adjust the frame size unless you have left or right indents other than 0 defined for the original paragraph). If necessary, you can then adjust the size and position further. Figure 3 shows the printout of a drop cap created with WordArt. As you can see, the curved lines are as smooth as with text-based drop caps.

There are a couple of size and positioning issues that you ought to be aware of when you're creating drop caps in either version of *WinWord*. First, although you can define the position by dragging the paragraph (in Print Preview mode in Version 1.1) or dragging the frame (in Page Layout mode in Version 2.0), you ought to avoid that approach. When you

Drop caps are a typographical technique in which you start the firs
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of a section, it's technically limited to characters that are alignec
character is even with the very top of the first line of text. If the top of the
first line of text, and the bottom of the character is aligned with the baseline

Figure 3: The drop cap in this printout was produced by WordArt, a mini-application that comes with *WinWord* 2.0. Graphics characters produced in WordArt have solid, smooth edges, rather than the jagged edges usually associated with characters produced by bitmap graphics programs.

position a drop cap this way, *WinWord* will automatically define the changed position as being relative to the page. That means the drop cap won't move with the paragraph if you make any further editing or format changes.

Ideally, you'll want the very top of the drop cap character aligned with the top of the first text line, and you'll want the bottom of the character aligned with the baseline of another line of text, so that the next line immediately below the drop cap wraps under the drop cap without a large gap. Adjusting the position of a drop cap for the correct positioning at the top is relatively easy. With *WinWord,* Version 2.0, you can specify Super/Subscript positioning, as already mentioned, with either a character or WordArt picture in a frame. With Version 1.1, you can insert a carriage return between the drop cap paragraph and the next paragraph, select the paragraph mark in the *new* paragraph, and adjust the height of the paragraph by adjusting the font size.

For precise positioning in Version 1.1, you may also want to format the drop cap as subscript and experiment with different subscript positioning, besides the default 3 points. In both versions, once you have the top of the drop cap positioned, you can then position the bottom by adjusting the size of the graphic or the font size of the text.

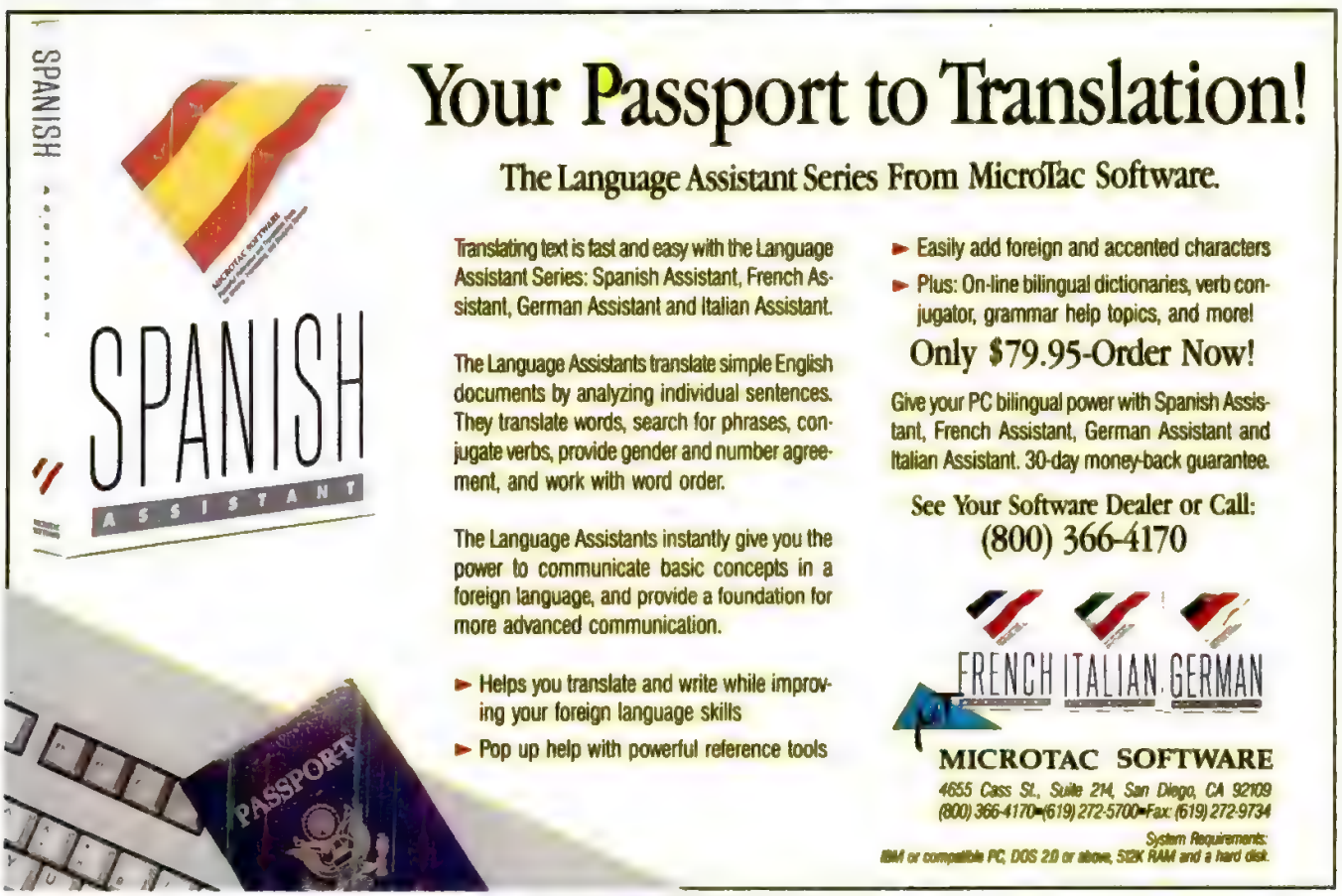
Unfortunately, no matter how you position the bottom edge of a text-based drop cap in *WinWord* 1.1, you will still have extra space below it, because *WinWord* reserves space below the text line for a descender. You can see this effect quite clearly in Figure 2, which shows the drop cap created with the DropCap macro in *WinWord* 2.0 (though the problem can be fixed easily in *WinWord* 2.0). The blank space below the drop cap is easily large enough for a line of text.

Note that this problem does not show up with a graphics image, as you can see in Figure 3. With *WinWord,* Version 1.1, you can simply crop the picture at the bottom of the figure. And in Version 2.0, you can not only adjust the frame for a picture, but adjust it to crop out the space reserved for the descender below a text-based drop cap. In short, you can get the same effect with text or a WordArt graphic in *WinWord* 2.0. However, WordArt may still be the preferred choice for drop caps if you want to create a fancy effect.

Another way around the problem is to define the drop cap paragraph with a border around it and 0.1 Distance from Text, then align the border top and bottom edges with the appropriate text lines. (To add a border in *WinWord* 1.1, choose Format Paragraph and set Border to Box. In *WinWord* 2.0, choose Format Border, and define the border in the Border Paragraphs dialog box.) However, in *WinWord* 1.1, you may be left with a choice between positioning the drop cap as relative to the page or accepting a border that extends above the text line. Once again, this isn't a problem with *WinWord* 2.0.

TIPS FROM WORKING WORDSMITHS

Tell the Working Word your latest word processing discovery; we'll pay you $50 for any tip we print. Please send your contribution on-disk along with a printout to The Working Word, *PC Magazine,* One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 10 for access instructions). ■



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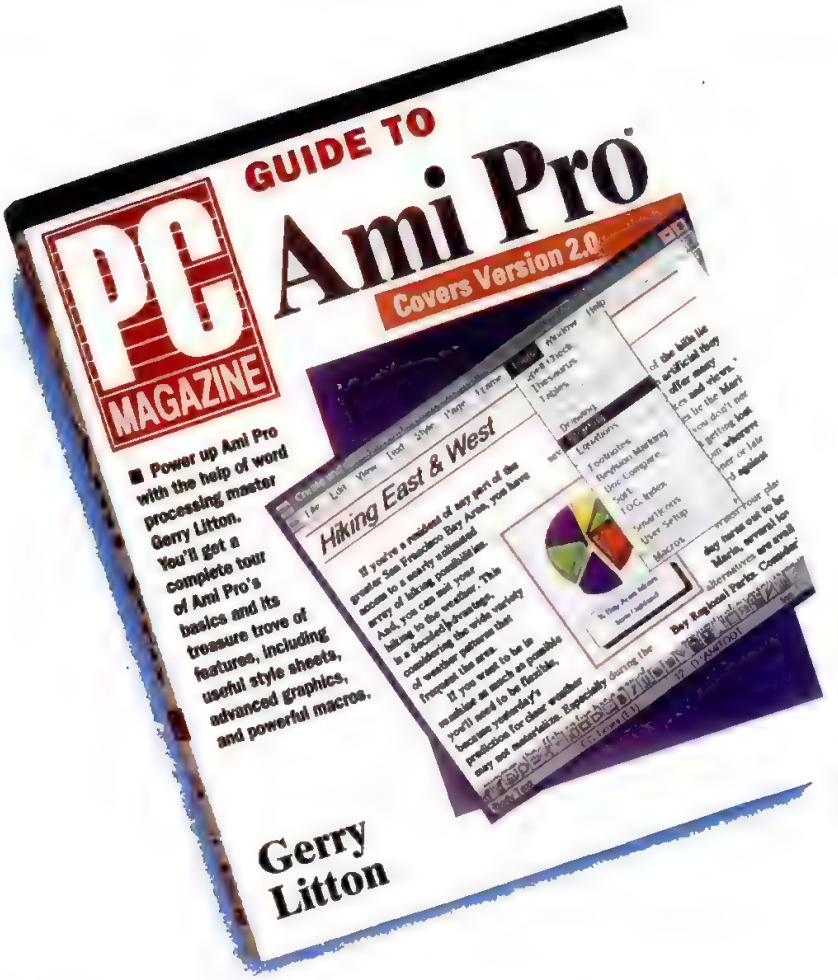

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CIRCLE 007 ON READER SERVICE CARD

by
Craig Stinson

Spreadsheets

OVERCOMING GRAPH TITLE LIMITATIONS

I regularly use *Quattro Pro* 3.0's graphing capabilities, but I only recently discovered a way around an annoying limitation in creating graph titles. If you enter the title in the box accessed by the Graph Text commands, you are limited to 39 characters. This limitation applies regardless of what font you use, so even if you were to set your title in 6-point type, you would still be limited to 39 characters. I sometimes need more than 39 characters, and it turns out that there is a way to get it.

The trick is to use a cell reference in the title box, rather than the actual text of the title. You can do this by exploiting a trick mentioned on page 377 of the *Quattro Pro* manual: If you enter a backslash followed by a cell address in the title box, *Quattro Pro* will use the contents of that cell as the title. What the manual does not tell you is that the 39-character limit no longer applies when you do this. If the text in the cell won't fit above the graph, *Quattro Pro* displays as much of the middle as will fit and truncates both ends. I then select a font that allows the title to fit.

The only drawback to this technique is that *Quattro Pro* won't update the graph title cell references if you restructure the spreadsheet. If, for example, you have your graph title in cell T59 and you insert a row above row 59, your title will now be in T60; but the reference in the graph title box will still read \T59, and the title will be whatever moved into that cell. This can be a real nuisance if you have 30 graphs defined in the spreadsheet. And *Quattro Pro*'s search-and-replace feature looks at cell ranges, so you can't use it on the graph titles directly.

The most obvious solution to this problem is to put the title cells in the upper-left corner of the spreadsheet, where they are unlikely to move. I don't care for the rigidity of this approach, but for quick analytical spreadsheets that no one else is likely to see or use, it might be appropriate.

A more flexible approach is to turn on *Quattro Pro*'s macro learn feature while you enter the title for one of the graphs, so that you get a macro fragment like the following:

```
{/ Graph;NameAutosave}y
{/ Graph;NameUse}YourGraph-
{/ Graph;Subtitle}{ESC}
\T60~
```

This saves changes automatically, displays YourGraph for edit, accesses and erases existing subtitles, and refers to cell T60 for the new subtitle. Paste the macro fragment into the spreadsheet, and recreate the last three lines once for each graph, changing the graph names and cell references appropriately. (If you were using cell references for more than just the subtitles, then obviously the macro fragment would be longer.)

Now, if you change the structure of the spreadsheet, you can use *Quattro Pro*'s search-and-replace feature to edit the macros, and then run them to update the title references.

Lynn L. Beavers
Fresno, California

PC MAGAZINE A safer and simpler solution is to put your title text in a named cell, then reference it by name. For example, you could name the cell containing your main title MAINTITLE. Then, you could use the /Graph | Text | 1st Line command and specify

```
\MAINTITLE
```

as your text. With this technique, you overcome the 39-character text limit but retain the freedom to reorganize your worksheet. If your named cell moves, *Quattro Pro* adjusts its name table to keep track of the new location, and the graph still picks up the correct title text.

Incidentally, *Quattro Pro*'s handling of graph titles is one of many cases where Borland copied Lotus to a tee, all the way down to the market leader's quirks and limitations. You'll find exactly the same graph-titling behavior in *Lotus 1-2-3*, Release 2.2 and Release 2.3. In *1-2-3*, as in *Quattro Pro*, the recommended solution is to reference named cells instead of addresses.

In Release 3.1 and *1-2-3 for Windows*, however, Lotus abandoned the "Lotus standard." In those versions, if you specify \A1 for a chart title and subsequently move the contents of A1 to A100, *1-2-3* will change the title reference to \A100.

- **OVERCOMING GRAPH TITLE LIMITATIONS:** Ways to transcend the 39-character limit on chart titles in *Quattro Pro* and *Lotus 1-2-3*.
- **TEXT BOXES AND TIMED MACROS:** Why timed *Microsoft Excel* macros may not perform when you use a text box.

TEXT BOXES AND TIMED MACROS

The AUTOSAVE.XLA add-in included with *Excel* 3.0 doesn't seem to work with text boxes. I have found that if I have Autosave running and I happen to be editing text in a text box when the scheduled save time arrives, the add-in stops working. I can't get it to work again without reloading it from disk. This problem makes Autosave dangerous to use, in my opinion. What do you think?

Keyuan Jiang
Nashville, Tennessee

PC MAGAZINE AUTOSAVE.XLA is one of many example add-in macros tucked away in the *Excel* 3.0 package; if you performed a default installation, you'll find it in the LIBRARY subdirectory of

Figure 1: AUTOSAVE.XLA adds the Autosave command, shown here, to *Excel*'s Options menu.

your EXCEL directory. When you load the .XLA file, the file's autoexec macro adds a command called Autosave to your Options menu. As Figure 1 shows, this command generates a simple dialog box in which you can choose from three periodic save intervals or turn the saving routine off. Apart from the bug discovered by Mr. Jiang, AUTOSAVE.XLA is a pretty handy item to have around. You can make it a permanent part of your *Excel* system by simply moving it from the LIBRARY subdirectory to a directory named XLSTART, located directly subordinate to your EXCEL directory. Anything stored in XLSTART gets loaded automatically with each new *Excel* session.

Mr. Jiang's text-box bug affects not only AUTOSAVE.XLA but also any other macro that uses the ON.TIME function. The ON.TIME function causes *Excel* to execute a specified macro at a specified time, provided *Excel* is in Ready, Copy, Cut, or Find mode when the time arrives. The function's optional *tolerance* argument governs the way in which *Excel* behaves if your system isn't in Ready, Copy, Cut, or Find mode at the appointed time. Provided the amount of time specified by the tolerance has not elapsed, *Excel* is supposed to go ahead and execute the macro named by ON.TIME as soon as it can—usually as soon as you return to Ready mode. If the tolerance argument is omitted, it is assumed to be infinite.

The ON.TIME function in AUTOSAVE.XLA does not specify a tolerance interval. Hence it should do its thing as soon as Mr. Jiang returns from his text box to his worksheet. Instead it quits for the day.

Fortunately, the bug was fixed in *Excel* 3.0a, a maintenance upgrade released by Microsoft in June 1991. You can tell whether you're using 3.0 or 3.0a by pulling down the Help menu and choosing About. The version number appears at the top of the dialog box, right above Microsoft's copyright line. If you're using 3.0, you can get a free upgrade to 3.0a by calling Microsoft at 800-426-9400.

HINTS, TIPS, QUESTIONS

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Access to local area networks now extends well beyond the office walls, thanks to the new LanFast DM 20 from UDS.

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CIRCLE 367 ON READER SERVICE CARD

UDS

MOTOROLA

by
Frank J. Derfler, Jr.

Connectivity

EASY CONNECTING

We just hired a part-time clerk in our small law office and want to give her access to the word processor on our 386/25 at the reception desk. Is there an inexpensive way to connect some kind of terminal to the 386 so we can share its power?

James V. Davis
New York, New York

Readers often ask for a simple way to share a single computer between two people. You can easily combine some off-the-shelf products and let one inexpensive computer access the resources of a more powerful machine without installing a full LAN.

My favorite recipe combines two PCs, one with at least a 386/20 processor and an 80MB or larger hard disk, and one with a single floppy disk, 640K of RAM, and practically any processor. You layer the $220 *DESQview 386* multitasking environment from Quarterdeck Office Systems (310-392-9851) into the 386 PC, fold the PCs together with an RS-232 null-modem cable, and glaze with a modem remote-control program like Norton-Lambert's (805-964-6767) $195 *Close-Up* or Triton Technologies' (908-855-9440) $195 *CoSession*.

The remote-control host program runs in one *DESQview* session on the 386. The other less powerful PC executes the remote package's client software from a floppy disk and connects over the RS-232 cable. Note that an RS-232 null modem cable crosses the wires going to pins 2 and 3 on each end to ensure that data transmitted from one machine goes to the receive connection on the other system's serial port. The person at the less expensive PC runs DOS applications in one multitasking session of the more powerful machine.

This setup is inexpensive and effective, but has some drawbacks. First, there is no security and no limitation on actions. The person using the *DESQview* session can read, erase, and run any files remotely. Obviously, this system works on the basis of trust and some administrative controls. It's best to give the remote user a specific set of subdirectories and tell that person not to stray. I'd also erase the FORMAT program from the DOS subdirectory and provide a program like Norton's *Safe Format* instead.

Second, it probably violates the software license if both people run the same copy of a program simultaneously. You must buy another copy of the software and should install it in a separate subdirectory; that way you'll be legal and avoid operating conflicts.

- EASY CONNECTING: A simple, low-cost way to share resources without using a LAN.
- ECONOMICAL VOICE PROCESSING: Robust voice mail without the robust price.

ECONOMICAL VOICE PROCESSING

We're interested in installing a voice-processing system to answer telephone inquiries, but the major players are far too expensive for our budget. Many of these systems run on a PC, so there must be less-expensive alternatives. Could you recommend a good, inexpensive system?

Rene Mathis
Morristown, New Jersey

Voice-processing systems are important and popular. It's a rare event when I make a business call and get to talk to a real person in real time. I always seem to start with an automated attendant, work through a call-selection system, and typically wind up with a voice mail system.

The market leaders in telephone voice-processing systems pioneered the technology back in 1986 on proprietary systems or minicomputers. Since then, many companies have moved their programs and voice hardware to PCs, but they still charge the minicomputer premiums.

Voice-processing products have three basic components: a hardware interface to the telephone network, software development tools to design and customize the applications, and the applications themselves. Digital signal processors have improved the quality of the telephone interface equipment and reduced costs, but pricing varies for the software elements of the packages.

If you want economical voice processing, you can either buy the hardware and software development tools and design the system yourself or you can purchase a system made to plug into an existing 286 or 386 computer. Keep in mind that voice processing requires hundreds of megabytes of disk space.

Natural MicroSystems (508-650-1300) offers a broad line of ISA and MCA voice hardware ranging in price from $379 to $1,795. Its products provide absolute control of the telephone connection so that people can't break into your voice system. Strategic Dimensions (404-423-9485) uses Natural MicroSystems voice-processing hardware in its *Natural Connection* line of products, which includes complete automated attendant and voice mail packages. *Natural Connection* runs on a PC under OS/2. Prices range widely depending on the number of lines and the type of services you need.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tip we print. Mail your contribution to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016. You may also contact Frank J. Derfler, Jr. via MCI Mail (MCI ID: 240-2931) or the LAN Labs fax machine (904-267-1578). ■

by
Sally Davis
Neuman

PC MagNet

UPLOADING FILES TO PC MAGNET

Most of you have downloaded files from the libraries of the PC MagNet forums. But have you ever *uploaded* a file? Many things may have prevented you from doing this, not the least of which are the prompts and questions you're asked when beginning to upload. But if you want to post shareware or a program you've written on PC MagNet, you'll need to know how to upload a file.

First, a word about restrictions. The first restriction is that you must own or have sufficient rights to any information you place on the service. This means, generally, that you cannot upload commercial software and that you cannot upload shareware or other software without the author's express permission. If you look at a program's README file, you'll find that most authors grant you the right to upload the program files, so long as you meet all of the conditions specified. Check the documentation *before* you upload.

The second restriction is that our host service, CompuServe, cannot handle filenames longer than six characters for the filename and three characters for the extension. This is why many of the filenames you see in *PC Magazine* are shortened to six letters, as in PCUNZP.COM.

Let's walk through a sample upload, explaining the prompts along the way. For clarity, we will assume that your default options are set to menu mode and you aren't using an autonavigation program.

Upon entering a forum, you will either see the forum's salutation (just hit Enter), or its main menu:

```
UTILFORUM/TIPS Forum menu
  1 INSTRUCTIONS
  2 MESSAGES
  3 LIBRARIES (Files)
  4 CONFERENCING (Ø participating)
  5 ANNOUNCEMENTS from sysop
  6 MEMBER directory
  7 OPTIONS for this forum
```

■ UPLOADING FILES TO PC MAGNET: If you have a program or shareware you'd like to place on our service for others to use, here's how to do it.

Choose option 3. A menu of the public libraries, such as the one below, will then be displayed:

```
Ø New Uploads
1 General Info
2 PCMag Utils
3 Lab Notes
.
.
.
15 Working Word
16 Gen Utils
```

Now choose the library you wish to upload to. Most users choose option 0. If you do so and press Enter, you will see the following menu:

```
UTILFORUM/TIPS Forum Library Ø New
Uploads
1 BROWSE Files
2 DIRECTORY of Files
3 UPLOAD a File (FREE)
4 DOWNLOAD a file to your Computer
5 LIBRARIES
```

Choose option 3. First you will be asked for a filename as it will appear on-line—remember only six characters! If you haven't selected a default protocol, you'll be asked to choose now.

Next, this menu will ask you to identify the file type you are posting:

```
Transfer types available -
1 ASCII
2 Binary
3 Image
4 Graphic:RLE
5 Graphic:NAPLPS
6 Graphic:GIF
```

Most of the files on-line are either ASCII (plain text files) or binary (.COM, .EXE, or .ZIP files, for example). Choose whichever option is appropriate.

Then you will be asked what the filename is on your own computer. Type in the filename, complete with its full path, and press Enter. Invoke whatever steps are required to upload a file with your communications program, and the upload process will begin. Most communications software keeps you constantly updated on the progress of the upload.

When the upload is complete, you will be asked for a description of the file. Clarity is essential; you have only 549 characters—or roughly seven 80-character lines—to describe your file. You should use as few excess spaces as possible in order to conserve characters. When you've finished describing your file, type /EXIT and press Enter.

Next, you will be asked to provide keywords for your upload. Keywords give users a quick way to search for files. For example

```
SCAN *.* KEY:MEMORY LIB:ALL
```

displays a one-line-per-file listing of all files in the forum that have the word *memory* designated as a keyword. You can use as many keywords as will fit on a full 80-character line. Press Enter to complete the line.

Then you will be asked for a title for your file. Though there are no strict guidelines for file titles, a simple, descriptive title is best. You get 49 characters.

Last, you'll get a sample of how your file description, keywords, and title will appear on-line. If everything looks fine, verify the upload by typing Y; if something is wrong, type N to repeat the process. You'll then be returned to the Library menu. ■

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2. Insert this sheet with
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    2. Arrow pointing to the fold
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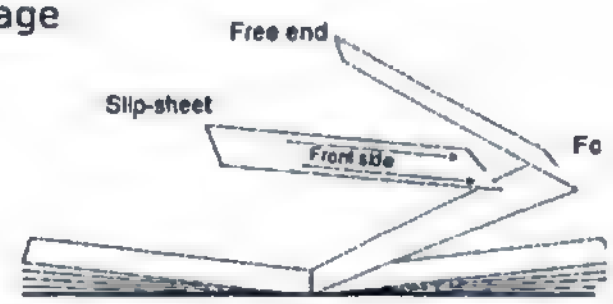
4. Close the page and slip-sheet



Inverted Back

GbsSlipBack-0018

Back

1. Follow instructions on the other side

1. Follow instructions on the other side

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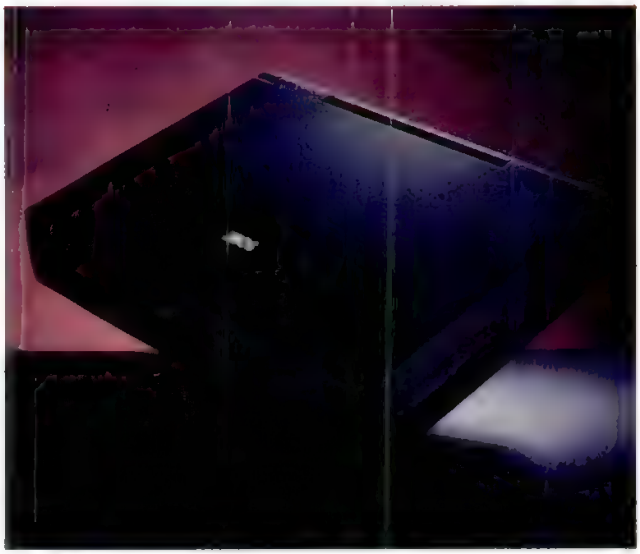

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City _____ State _____ Zip _____

Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State _____ Zip _____

Employer _____ Since? (Mo./Yr.) _____

Monthly Gross Salary $ _____ Daytime Bus. Phone (_____) _____

Previous Employer _____ From - To

Occupation _____

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_____ Relationship _____

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Savings Account ☐ Yes ☐ No

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VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

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City _____ State _____ Zip _____

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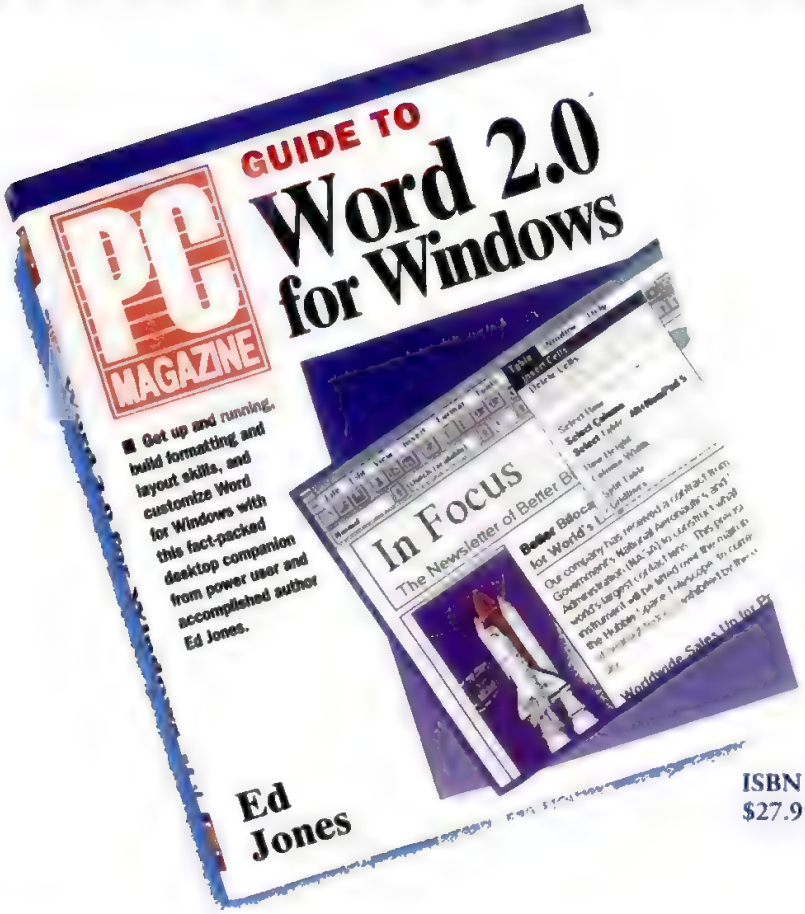

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CIRCLE 004 ON READER SERVICE CARD

by
Douglas Boling

Utilities

DOSCLIP.EXE: A Clipboard for All Sessions

How many times have you wanted to copy a block of text from one file to another? If you're running under Windows, you can use its internal clipboard. But DOS has no clipboard—until now.

DOSCLIP, this issue's free utility, supplies the cut-and-paste services of the Windows clipboard to the DOS environment. Indeed, DOSCLIP even allows DOS applications to copy data to and from the Windows clipboard itself.

A TSR utility, DOSCLIP captures a user-marked block of text on-screen into a special memory buffer. When the text in the clipboard is needed, DOSCLIP pastes it into the application by feeding the stored characters into the keyboard buffer. Thus, DOS applications don't need to be specially designed to use DOSCLIP. To the application, pasting from the DOSCLIP clipboard simply looks as though the user is typing at the keyboard.

You can download a working copy of DOSCLIP.COM (as DOSCLI.COM) from PC MagNet, as explained in the sidebar "Downloading Utilities." The assembly language source code and a BASIC listing that will create DOSCLIP.COM when you run it are also available for downloading, as is a .ZIF file that will allow you to customize the default hotkeys with Michael Mefford's PATCH.COM utility. For those people who don't have access to a modem, the source code is available by mail or fax: Send your request to Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY, 10016; no phone calls, please.

USING DOSCLIP

DOSCLIP installs itself in memory when you type its name at the DOS prompt. Its full syntax is

```
DOSCLIP [/B] [/U]
```

The optional /B command line parameter tells DOSCLIP to use the video BIOS to communicate with the screen. This switch is needed only by a very few exotic video adapters that don't follow the IBM standard video design. As usual, the /U parameter tells DOSCLIP to remove itself from memory. Remember, TSRs must be removed in the reverse of the order they were installed.

■ DOSCLIP lets you cut and paste not only in Windows, but in DOS applications, too.

Once installed, pressing Alt-C pops DOSCLIP into action. A one-line banner across the top of the screen announces that DOSCLIP is ready to capture data, and a block cursor replaces the standard DOS underline cursor.

The standard cursor-movement keys (the four arrow keys, PgUp and PgDn, Home, and End) let you maneuver the DOSCLIP block cursor anywhere on the screen. Additionally, the Ctrl-Right arrow and Ctrl-Left arrow let you move the cursor laterally in eight-character jumps. After positioning the cursor at one corner of the block of text to be captured, hold down the Shift key and move the cursor to the diagonally opposite corner, then release the Shift key. Text inside the defined area is displayed in reverse (black on white) video. When you now hit either Enter or the C key, the text in the highlighted block will be copied into the DOSCLIP clipboard and DOSCLIP will return to the background. To undefine a marked block without storing it, simply move the cursor or hit the Esc key.

The contents of the clipboard remain in memory until you store a new block or until you power down or reboot. You can thus paste the material into several applications successively. To paste from the clipboard, simply position the cursor where you want the text to appear and press Alt-V. The stored characters will be fed through the keyboard buffer, just as if you were typing them into the active application. You can also paste from the clipboard by pressing Alt-C to pop up DOSCLIP and then pressing V.

The Alt-C and Alt-V hotkeys approximate the Windows 3.1 standard for clipboard accelerator keys. Windows 3.0 uses the convoluted Ctrl-Ins and Shift-Ins CUA standard, whereas Version 3.1 shifts to the more intuitive Ctrl-C and Ctrl-V Macintosh standard. I selected Alt-C instead of Ctrl-C as the default pop-up key, because using the latter caused problems with some DOS applications when used outside of Windows. If Ctrl-C does not cause such problems with your DOS applications, however, you'd be well advised to implement the new Windows 3.1 arrangement, as that seems to be the wave of the future. To modify the hotkeys to any key combinations you wish, just download the DOSCLIP.ZIF file (posted as DOSCLI.ZIF on PC MagNet) and use PATCH.COM to make the changes.

COMPATIBILITY

DOSCLIP is compatible with Versions 3.0 and 3.1 of Windows. For maximum effectiveness, DOSCLIP should be installed before Windows; this will make

the utility available to all DOS sessions (and DOS-mode programs) under Windows. So loaded, DOSCLIP can even be active in more than one session at a time!

Data can be captured in one DOS session and pasted into another. If Windows is running in 386 Enhanced mode, DOSCLIP automatically coordinates its clipboard data with the Windows clipboard. This allows data captured from DOSCLIP to be pasted into Windows applications and vice versa. If you don't have enough memory to install DOSCLIP before starting Windows (the utility takes up 10K of RAM), you can install it after Windows, in a DOS session. When installed this way, DOSCLIP won't be able to communicate between sessions, but it will still coordinate its data with the Enhanced mode Windows clipboard.

DOSCLIP is also compatible with the DOS 5.0 Shell. If you install it before the DOS Shell, DOSCLIP will be able to pass clipboard data between DOS programs running under the shell. In fact, DOSCLIP will work with any task-switching program that follows the new DOS 5.0 task-switching standard.

HOW IT WORKS

DOSCLIP interacts with programs by mimicking the user's interfaces. For example, to read data from a program, DOSCLIP reads the screen and copies the data onto the clipboard. The clipboard itself is simply a block of memory reserved when DOSCLIP is installed. To paste data into a program, DOSCLIP simply stuffs the characters from the clipboard into the keyboard buffer.

The code used by the copy routine to block data on the screen comes directly from my previously published ADDIT utility. DOSCLIP also uses the ADDIT attribute-compression algorithm to reduce the installed memory requirements. For an explanation of how these portions of DOSCLIP work, let me refer you to the discussion of ADDIT in the February 11, 1992, Utilities column.

When the user copies a block of data from the screen, DOSCLIP reads the appropriate area of the video buffer. Each character on the screen uses 2 bytes. One byte is for the character itself; the other is an attribute byte that determines how the character is displayed. DOSCLIP copies the character byte to the clipboard and ignores the attribute byte. As each line is read, a carriage return character is appended, and after the entire block has been read, a 0 byte ends the data stored in the clipboard.

Pasting the data is equally simple. When the user presses the Paste hotkey combination and there is data in the clipboard, DOSCLIP sets the paste flag. Each time the system timer interrupt (interrupt 8) is called, DOSCLIP checks the paste flag and, if set, stuffs characters from the clipboard into the keyboard buffer. If the keyboard buffer is full at the time, DOSCLIP simply waits until the next timer tick and then checks the buffer again. From then on, until all the data in the clipboard has been pasted, DOSCLIP attempts to stuff characters into the keyboard buffer during each timer interrupt.

The clipboard itself comprises a block of memory and a few pointers. There is a pointer to the buffer, a word that keeps the size of the data in the clipboard, and a pointer that is used by the paste routine to point to the next byte to be pasted. If Enhanced mode Windows is running, the clipboard data is kept in the Windows clipboard, and the DOSCLIP clipboard is used simply as a buffer.

Although DOSCLIP is a "normal" TSR in that it uses now-standard techniques to install and pop up, it does have some new, rather interesting code that enables it to interface with the DOS 5.0 task switcher. The task-switcher standard is used both by the DOS 5.0 Shell and by Windows 3.1 when running in Standard mode. To make DOSCLIP compatible with Enhanced mode Windows, the old Win/386 DOS box interface is also used. Since the standard TSR code has been frequently discussed in previous Utilities columns, I'll concentrate on the new task-switcher interfaces.

THE DOS TASK-SWITCHER INTERFACE

DOS 5.0's release came as a welcome relief to TSR writers, for with it has come documentation for the previously undocumented calls and techniques needed to write stable memory-resident programs. Not only are these calls confirmed in the MS-DOS 5.0 *Programmer's Reference*, but a special section on writing TSRs has also been included. Sadly, it would be too much to hope that such a DOS *peristroika* would be complete. A number of DOS interfaces still remain undocumented, particularly in the Multiplex interrupt (INT 2Fh) area.

While not completely documented, the Multiplex interrupt holds the key to accessing the DOS task-switcher application program interface (API). The material on the task-switcher interface is bundled in with the discussion of interrupts in

PC MAGAZINE UTILITIES UPDATES

As with all good software, the programs presented in *PC Magazine* are upgraded and improved. You can get the modified versions by downloading them from PC MagNet. Here's a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities. If the filename listed here is longer than six letters, search on the first six letters, using the same extension.

ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.5
BCOPY, Version 1.2
Benchmark Series, Version 6.0a (BEN60A.EXE)
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.5
CMDEDIT.EXE, Version 2.8
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 3.1
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
PANDORA.COM, Version 2.4
PCACCESS.EXE, Version 1.1
PCMANAGE.EXE, Version 1.1
RN.COM, Version 3.0
SCHEDULE.COM, Version 1.1
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
TPFST-AT.COM, Version 1.1
ZCOPY.COM, Version 1.4

For a complete list of all the programs available from the PC MagNet Software and Utilities Database Library, download PCMCAT.ZIP.

A downloadable index to *PC Magazine*'s product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine* Reviews Index for January 1988 to June 1991. It requires the search files in PCSRCH.EXE. Read the information file PCM.INF before you download any of these files. ■

chapter 7 of the MS-DOS 5.0 *Programmer's Reference*. The task-switcher API allows programs to know when a DOS session is being created, activated, suspended, or destroyed. The API also enables programs to create memory blocks unique to each DOS session.

Consideration of a typical session will show why it is important to have memory unique to each DOS session. Suppose that a TSR is loaded and that Windows or the DOS task switcher is launched. The user then starts a DOS box and accesses the TSR. The TSR switches to its internal stack and pops up. So far, no problems arise. However, if the user then starts *another* DOS box and attempts to pop up the TSR in the second DOS box, one of two bad things can happen. If the TSR isn't smart enough to know that it is already active in another DOS box, the internal stack used by the first DOS box will be overwritten, causing the TSR in the first DOS box to crash. If the TSR does know that it is already active elsewhere, its only option is to disappoint or confuse the user by not popping up. While this prevents a system crash, it would surely be better if the TSR could be active in both DOS sessions at once.

The easiest way to enable a TSR to be active in multiple sessions is to use *instance memory*. Instance memory is a block of memory that is unique to a particular DOS session. Each session uses the block at the same address, but as one DOS session is swapped out and another is activated, the instance memory is also swapped out with the old session and is replaced by data from the new session. This allows the TSR to maintain a unique stack—and any other necessary data—for each session while sharing one block of memory that contains both code and global data.

When the DOS task switcher starts, it asks all currently resident TSRs if they want any instance memory. The TSRs can then respond with a list of blocks of memory that must be unique for each session. Once an instance memory block is established, the task switcher will swap that block each time the user switches between DOS sessions.

DOSCLIP requests two instance memory blocks. The first contains the variables and data necessary for DOSCLIP to operate. The second instance memory block is used for the DOSCLIP stack. DOSCLIP also uses data that must not be instanced, of course. If the clipboard buffer itself were instanced, for example, DOSCLIP could not pass data between DOS sessions.

DOSCLIP requests instance memory blocks by intercepting the task switcher Identify Instance Data notice. The Identify Instance Data notice is made through the Multiplex interrupt. When DOSCLIP is installed, it hooks the Multiplex interrupt and screens all Multiplex calls. The Identify Instance Data notice takes the form of a Multiplex interrupt with AX = 4B05h. When DOSCLIP detects this notice, the flags register is pushed on the stack and the old Multiplex interrupt vector is called. When the call returns, a pointer to the DOSCLIP's instance memory structure is placed in ES:BX. The current values of ES:BX are placed in a field in the instance memory structure. Another field in the instance memory structure points to a list of instance memory blocks, each of which can be up to 64K in size. An example of the code needed to create instance memory blocks is listed in Figure 1. Note that, with a few simple additions, the same code also works for Enhanced mode Windows.

There is more to the task-switcher API than creating instance memory, however. The API also includes a method for notifying programs of significant events and for controlling these events. Two methods for telling the task switcher to notify your program are documented in the MS-DOS 5.0 *Programmer's Reference*.

The first method is to intercept the Built Notification Chain notice that is sent by the Multiplex interrupt. When a program detects a Multiplex interrupt with AX = 4B01h, it first passes the interrupt down the chain by pushing the flags register and calling the old interrupt vector. After returning, ES:BX is saved in a callback structure in the program and ES:BX is then modified to point to this structure. While DOSCLIP doesn't use the switcher-notification process, a short discussion is provided for completeness.

INT 2FH CODE — **PARTIAL LISTING**

```
;=================================================================
; MUXINT processes DOS multiplex interrupt (Int 2Fh)
;=================================================================

;Switcher instance memory structures

StartupInfo      =       $
 sisVersion      dw      3                       ;Switcher structure ID
 sisNextDev      dd      0                       ;Ptr to prev startup structure
 sisVirtDevFile  dd      0                       ;Ptr to name of opt dev drvr
 sisReferenceData dd     0                       ;Data for Win dev drivr
 sisInstData     dd      0                       ;Ptr to instance mem list

DataBlockPtr     dd      0                       ;Ptr to instance data
DataBlockSize    dw      0                       ;Size of instance data
StackBlockPtr    dd      0                       ;Ptr to instance stack
StackBlockSize   dw      0                       ;Size of instance stack
            dd      0                             ;Ptr to next block = 0 to
            dw      0                             ;  terminate list

muxint           proc    far
                 assume  cs:code,ds:nothing,es:nothing
                 cmp     ax,1605h                ;See if Windows launch
                 je      mux_winstart
                 cmp     ax,1606h                ;See if Windows terminate
                 je      mux_winend

                 cmp     ax,4b05h                ;See if switcher get instance
                 je      init_instance           ;  data.
muxint_jmp:
                 jmp     cs:[int2fh]             ;Jump to old int
mux_winend:
                 test    dx,01h                  ;See if enhanced mode Windows
                 jne     muxint_jmp
                 dec     cs:win_enhanced         ;Clear Enhanced mode win flag
                 jmp     short muxint_jmp
mux_winstart:
                 test    dx,01h                  ;See if enhanced mode Windows
                 jne     init_instance
                 inc     cs:win_enhanced
init_instance:
                 pushf
                 call    cs:[int2fh]             ;Call old Mux int
                 mov     word ptr cs:[sisNextDev],bx ;Save ptr to
                 mov     word ptr cs:[sisNextDev+2],es ;prev struc
;
;Init switcher structures
;
                 push    ax
                 mov     ax,cs
                 mov     word ptr [DataBlockPtr+2],ax
                 mov     word ptr [DataBlockPtr],offset DataBlock
                 mov     word ptr [DataBlockSize],INSTDATASIZE

                 mov     word ptr [StackBlockPtr+2],ax
                 mov     word ptr [StackBlockPtr],offset end_of_resident
                 mov     word ptr [StackBlockSize],STACKSIZE

                 mov     word ptr [sisInstData+2],ax
                 mov     word ptr [sisInstData],offset DataBlockPtr
                 pop     ax
                 push    cs                      ;ES:BX point to switcher struc
                 pop     es
                 mov     bx,offset StartupInfo
                 jmp     short muxint_exit
muxint_exit:
                 iret
muxint  endp
```

Figure 1: This code, which uses the Enhanced mode Windows Multiplex interrupt API and the DOS task-switcher API, creates the instance memory used by DOSCLIP in DOS sessions.

As shown in Figure 2, the switcher notifies DOSCLIP of a number of different situations that deal with the currently active DOS session. Two sets of functions, Query Suspend and Suspend Session, and Activate Session and Session Active, may appear to involve duplicate notifications, but are actually subtly different. When the switcher needs to suspend a session, it sends the Query Suspend notification. At this time, the session is still active and all programs receiving the notification can call DOS or switcher functions. If a program wishes to stop the suspension, it simply returns a nonzero value in AX.

After all programs have agreed to the Query Suspend notification, the switcher starts the process of actually suspending the session. The task switcher disables interrupts and sends one final notice, Suspend Session. At this point, the programs in the notification chain are given one last chance to stop the suspend session process. Programs are not allowed to make any system calls during this notice; their only option is to allow or prevent the session switch. If any program rejects the session switch at either notification, the switcher stops the switching process and returns control to the current session. The double-notice procedure allows programs—especially interrupt-driven ones—the opportunity to suspend their activities gracefully.

The Activate Session and Session Active notices work in a somewhat similar manner. The Activate Session notice is sent as an early notification that a session is to be activated. As with the Suspend Session notification, no system calls can be made during this notice. The Session Active notification allows programs to make any necessary system calls in preparation for the session actually going active.

The suspend and activate notifications give programs a chance to execute critical sections of code without worrying that the task switcher will suspend the program in the meantime. While a program could itself force the user never to suspend it, the notifications are meant to be used simply to delay a switch until the program has completed a critical section.

The remaining notifications listed in Figure 2 allow programs to determine when a session is being created and destroyed and whether a switcher is starting or terminating. As with the other notifications, programs can stop the action simply by returning a nonzero value in AX. A program may refuse to allow a new DOS session if it has run out of some internal resource. You should note that the switcher API explicitly allows another switcher to start while the current switcher is running. Thus, programs should not assume that only one switcher can be running on a machine at a time.

Up to this point, we've considered the interface between the switcher and programs as going in only one direction: "Don't call us, we'll call you." However, there is also a way for programs to call the switcher. To call the switcher, a program performs a Multiplex interrupt with AX = 4B02h and ES:DI = 0:0. If the call returns with AX equal to 0 and ES:DI is not 0, then a switcher is installed and the value in ES:DI points to the service routine of the switcher.

The switcher API provides a number of service functions that enable programs and other switchers to determine the state of the system. Once a task switcher has been discovered, a program should determine the switcher version by making a far call to the service routine address with AX equal to 0. The Get Version service function returns a pointer to a structure that contains such information as the name of the switcher, the switcher version, and whether any other switchers are loaded.

The Test Memory Region service function allows a program to determine whether a given memory region is local to a specific session or global to the entire machine. Two other service functions, Suspend Switcher and Resume Switcher, allow another switcher to take over the machine. These two functions are used only by other switchers; application programs should never need them.

The Multiplex interrupt method we've been considering so far is not the only way to access the notification chain. Hook Notification Chain and Unhook Notification Chain functions provide a second method. In theory, given two methods of hooking the notification chain, a program should use both methods to ensure that it will be notified. Ironically, however, the current implementation of the DOS 5.0 switcher ignores the Hook and Unhook Notification Chain service functions.

SWITCHER NOTIFICATION FUNCTIONS

AX = 0, Init Switcher	Notifies programs that a new switcher is starting.
AX = 1, Query Suspend	Notifies programs that the switcher is preparing to perform a task switch.
AX = 2, Suspend Session	Notifies programs that a session switch is about to take place.
AX = 3, Activate Session	Notifies programs that a session is about to become active.
AX = 4, Session Active	Notifies programs that a session has become active.
AX = 5, Create Session	Notifies programs that the task switcher is about to create a new session.
AX = 6, Destroy Session	Notifies programs that the task switcher is destroying a session.
AX = 7, Switcher Exit	Notifies programs that the task switcher is no longer active.

Figure 2: The task switcher informs programs of events by means of these notification calls.

ENHANCED MODE WINDOWS INTERFACE

Today's TSRs must not only work with the switcher API, but must also be compatible with the entirely different interface used by Enhanced mode Windows. Enhanced mode Windows uses a Multiplex interrupt interface to its DOS control program similar to that used by the old Win/386 2.*x* interface. The situation is further complicated because Windows 3.1 uses the DOS task-switcher interface when operating in Standard mode and the Win/386 switcher interface when running in Enhanced mode. Windows 3.0, on the other hand, uses the Win/386 interface when running in Enhanced mode and doesn't even have a switcher interface when running in Real or Standard modes.

In order to determine whether Enhanced mode Windows is running, DOSCLIP performs a Multiplex interrupt with AX =

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DOSCLIP Command

Douglas Boling April 14, 1992 (Utilities)

Purpose: A TSR utility that provides Windows-like cut-and-paste facilities to applications running under DOS, and which permits transfer of text blocks between Windows (in 386 Enhanced mode) and DOS applications when running under Windows.

Format: `DOSCLIP [/B] [/U]`

Remarks: DOSCLIP is loaded from the DOS prompt and requires 10K when memory resident. The optional /B switch parameter is required only with video boards that do not conform to the IBM video standard. Entering DOSCLIP with the /U switch uninstalls the program, subject to the usual TSR limitations.

The default pop-up hotkey is Ctrl-D, which brings up DOSCLIP over the application and replaces the underline cursor with a block-style cursor used to define an on-screen text area to be saved to the clipboard. The arrow keys, PgUp and PgDn, Home, and End are used to move the DOSCLIP cursor; Ctrl-Left Arrow and Ctrl-Right Arrow move it laterally in eight-character jumps. To block an area, place the cursor in one corner and move it to the diagonally opposite corner while holding down the Shift key. After releasing the Shift key, the defined area is saved to the clipboard by pressing Enter or the D key.

A defined text area can be pasted into another application by pressing Ctrl-V or by bringing up DOSCLIP with Ctrl-D and then pressing V. The default pop-up and paste hotkeys can be changed by using PATCH.COM (Utilities, November 12, 1991) and the DOSCLIP.ZIF file, both of which can be downloaded from PC MagNet.

When used in conjunction with Windows, it is desirable to load DOSCLIP before starting Windows, memory permitting. This will make DOSCLIP available to all Windows sessions. Windows should also be run in 386 Enhanced mode if possible so that data captured in DOSCLIP can be pasted into Windows applications and vice versa.

DOS ACCESS TO WINDOWS

```
1700. Identify Win OldApp Version
      Entry:  AX = 1700h
      Exit:   AX <> 1700 -> AX = Version number

1701. Open Clipboard
      Entry:  AX = 1701h
      Exit:   AX <> 0 -> Clipboard opened

1702. Empty Clipboard
      Entry:  AX = 1702h
      Exit:   AX <> 0 -> Clipboard emptied

1703. Set Clipboard
      Entry:  AX = 1703h
                DX = Type of data
                     1 - Text          2 - Bitmap
                     3 - Metafile      4 - SYLK
                     5 - DIF           6 - TIFF
                     7 - OEM Text
                ES:BX = Pointer to data
                SI:CX = Size of data
      Exit:   AX <> 0 -> Clipboard set

1704. Get Clipboard Size
      Entry:  AX = 1704h
                DX = Type of data (See Set Clipboard for types)
      Exit:   AX = 0 -> No data in requested format
                     Else, DX,AX - Size of clipboard data

1705. Get Clipboard Data
      Entry:  AX = 1705h
                DX = Type of data (See Set Clipboard for types)
                ES:BX = Pointer to buffer
      Exit:   AX <> 0 -> Clipboard read

1708. Close Clipboard
      Entry:  AX = 1708h
      Exit:   AX <> 0 -> Clipboard Closed
```

Figure 3: Using the Multiplex interface, DOS programs can access Windows' internal clipboard (in 386 Enhanced mode) with these functions.

1600h when it starts. If Enhanced mode Windows is running, AX will return with a value equal to the Windows version number. If the interrupt returns with AL = 0 or 80h, then Enhanced mode Windows isn't running.

DOSCLIP also checks for the Windows Launch broadcast, which is a Multiplex interrupt inaugurated with AX = 1605h. Windows sends out this notification to all programs to indicate that it is starting. If a program wants to prevent Windows from starting, all it needs to do is to intercept this call and place a nonzero value in CX. Windows will then abort its start-up and return to DOS. Programs that preempt Windows in this manner should print a message to the screen to tell the user why Windows did not start. While not very common, there are programs that can't allow Windows to be run if they are loaded.

The Windows Launch broadcast has two other important functions. The first is to indicate whether Windows will be running in Enhanced mode or Standard mode. Bit 0 of DX is set if Windows will be running in Enhanced mode. The other use for this function is to query programs for a list of their instance memory requirements. Fortunately, the process and data structures needed to create the instance memory are identical to those used by the DOS task switcher. This similarity allows one routine to be used to create instance memory both for Enhanced mode Windows and for the DOS task switcher.

One difference between the Enhanced mode Windows start-up call and the switcher create instance memory call is the ability in the Windows start-up to request that a specific Windows device driver be loaded. In order to load a driver, the program should fill the sisVirtDevFile field with a pointer to the ASCIIZ name of a Windows device driver. The sisReferenceData field allows a program to pass a double-word data value to the device driver when it starts up.

When Windows terminates, it sends a Multiplex interrupt with AX = 1606h. As with the Windows Launch broadcast, bit 0 of DX indicates whether Windows was running in Standard or Enhanced mode. The other functions available to DOS programs using the Win/386 API are used mainly by programs communicating with Windows virtual device drivers.

THE CLIPBOARD INTERFACE

We've seen how Enhanced mode Windows uses the Multiplex interrupt to interface with DOS-mode programs for switcher functions. A similar interface is available to DOS programs for accessing the Windows clipboard. This interface uses Multiplex ID 17 to enable DOS programs to read from and write to the same Windows clipboard that normal Windows programs access. A list of the clipboard functions available to DOS applications using the Multiplex interface is shown in Figure 3.

As with most Multiplex interrupt APIs, function 0 is an installation check. You simply initiate a Multiplex interrupt with AX = 1700h to determine whether the interface is available. The remaining functions allow programs to open, read, write to, and close the clipboard.

When DOSCLIP needs to copy data to Windows' clipboard, it opens the clipboard with a Multiplex interrupt with AX = 1701h. The data is then sent to the clipboard using the Write Clipboard function. In this particular function, ES:BX points to the data and DX indicates the type of data that is being sent. After the data has been forwarded, Windows' clipboard is closed, using the Close Clipboard function.

DOSCLIP reads the clipboard with a process similar to that for a clipboard write. The only difference is the use of the Get Clipboard Size function, which ensures that the data is not too large for the DOSCLIP buffer. While the data in Windows' clipboard can be of many different types, ranging from bitmaps to *Microsoft Word* format, DOSCLIP reads and writes only text data.

While examining the DOSCLIP code serves to show the capabilities of the new DOS switcher and Enhanced Windows interfaces, it is in actually using the DOSCLIP utility that the power and convenience of these interfaces can be most fully appreciated. ■

Douglas Boling is a contributing editor of PC Magazine.

by
Charles Petzold

Environments

Making Music: An Introduction to MIDI Sequencing

The minimum-standard Multimedia PC required to run Microsoft Windows with Multimedia Extensions (Multimedia Windows) contains an electronic music synthesizer. A Windows program can play music on this synthesizer by sending it messages using the protocol called MIDI (Musical Instrument Digital Interface).

The Multimedia PC also contains a MIDI Out port for optionally connecting an external MIDI synthesizer, and a MIDI In port for optionally connecting an external MIDI *controller*. MIDI controllers look a lot like ordinary musical instruments—keyboards, clarinets, violins, and drum pads—except that they generate MIDI messages when you play them.

The Multimedia Windows application program interface (API) lets you access this MIDI hardware through either a low-level or a high-level API: The low-level API consists of functions beginning with the prefix midiIn (for reading MIDI sequences coming from an external controller) and midiOut (for playing music on the internal or external synthesizer). Despite the term *low-level*, you don't need to know anything about the hardware interface of the MIDI board when using these functions.

The high-level API is the Media Control Interface (MCI). Currently, MCI cannot be used to read MIDI messages coming from an external controller. It can only play compositions encoded in standard MIDI files through the internal or external synthesizer. MIDI files consist largely of sequences of MIDI messages with timing information. We'll be taking a close look at MIDI files in an upcoming column.

LOW-LEVEL MIDI OUTPUT

I'd like to begin by examining the low-level MIDI output functions. In the last issue, we saw how to use the midiOutGetNumDevs function to determine the number of MIDI output devices and midiOutGetDevCaps to get information about each of these devices.

> ■ To play music on a MIDI synthesizer, the music must be translated into a series of numbers, but as the program presented here shows, translating even a piece of music that sounds simple is not always straightforward.

If you have only one MIDI board in your Multimedia PC (which is normal), then midiOutGetNumDevs reports that there are two MIDI output devices. One of them is the internal MIDI synthesizer and the other is an external MIDI synthesizer connected to the MIDI Out port of your MIDI board. (There is no way for Multimedia Windows to know whether you actually have an external synthesizer connected to this port.)

As I discussed in the last issue, there is also a third MIDI output device called the MIDI Mapper. The MIDI Mapper is actually one of the two real MIDI synthesizers (internal or external) as selected by the user in the MIDI Mapper utility invoked from the Control Panel.

You can open any of these three MIDI output devices in preparation for sending them messages and playing music. If you open one of the real devices, MIDI messages are passed unmodified from your program to the synthesizer. Now this is important: To use a real MIDI device in an intelligent manner, your program must have some knowledge about the device. In particular, you must know about the instrument voice mappings of the synthesizer.

However, if you open the MIDI Mapper device, the MIDI messages your programs send to the device are altered through mapping tables. These mapping tables can be defined or modified using the Control Panel MIDI Mapper utility. The intent is to achieve something approaching device independence.

To open a MIDI output device in preparation for playing music, you call midiOutOpen:

```
wError = midiOutOpen (&hMidiOut,
  wDeviceID, dwCallBack,
  dwCallBackData, dwFlags) ;
```

The function returns 0 if successful or an error code if not. If you've specified the function parameters correctly, an error usually indicates that the MIDI device is already in use by another program.

The first parameter is a pointer to a variable of type HMIDIOUT that receives a MIDI output handle for use in subsequent MIDI output functions. The second parameter is the device ID. To use one of the real MIDI devices, this parameter can range from 0 to one less than the number returned from midiOutGetNumDevs.

Normally there are two real devices, so the wDeviceID parameter will be 0 or 1 to use a real device. To use the MIDI Mapper device, you need to set the wDeviceID parameter to the constant MIDIMAPPER (which is defined in MMSYSTEM.H as -1).

In most cases, you'll probably set the last three parameters of midiOutOpen to NULL or 0. I'll discuss these parameters later in this column.

SENDING MIDI MESSAGES

Once you open a MIDI output device and obtain the handle, you can begin sending MIDI messages to the device. You do this by calling

```
wError = midiOutShortMsg
  (hMidiOut, dwMessage) ;
```

The first parameter is the handle obtained from midiOutOpen. The second parameter is a 1-, 2-, or 3-byte MIDI message packed into a DWORD—a 32-bit unsigned long integer. If you've opened a real device, the function simply sends the message to the device. If you've opened the MIDI Mapper device, the message can be modified on its way to the device.

As I discussed in the March 17, 1992, issue, MIDI messages begin with a status byte, followed by 0, 1, or 2 bytes of data. The status byte forms the least significant byte of dwMessage, the first data byte is the next significant byte, and the second data byte is the next. The most significant byte of dwMessage is 0.

For example, to play a middle C (the note 0x3C) on MIDI channel 5 with a velocity of 0x7F, you need a 3-byte Note On message: `0x95 0x3C 0x7F`. So the dwMessage parameter to midiOutShortMsg is 0x007F3C95.

The three essential MIDI messages are Program Change (to change the instrument voice for a particular channel), Note On, and Note Off. After opening a MIDI output device, you should always begin with a Program Change message and you should send an equal number of Note On and Note Off messages.

When you're all done playing the music, you can close the MIDI output device:

```
wError = midiOutClose (hMidiOut) ;
```

The midiOutOpen, midiOutShortMsg, and midiOutClose functions are the three essential functions you need for using the low-level MIDI output API.

A SAMPLE PROGRAM

So, let's play some music! The BACHTOCC program shown in Figures 1 through 4 plays the first measure of the toccata section of J.S. Bach's famous "Toccata and Fugue in D Minor" for organ. As usual, you need to have the Multimedia Development Kit (MDK) installed to compile this program. If you're using Borland C++ 2.0, the MDK must be installed in the same directory as the compiler. To compile for Microsoft C, you use

```
NMAKE BACHTOCC.MSC
```

To compile for Borland C++, use

```
MAKE -fBACHTOCC.BCP
```

When the BACHTOCC program starts up, it sets the Windows timer, calls midiOutOpen to open the MIDI Mapper device, and midiOutShortMsg to send MIDI Program Change messages. On receipt of a WM_TIMER message, BACHTOCC plays the musical notes by calling midiOutShortMsg. When finished, BACHTOCC closes the device by calling midiClose and then terminates.

BACHTOCC.MSC — COMPLETE LISTING

```
#-----------------------------------------
# BACHTOCC.MSC make file for Microsoft C 6.0
#-----------------------------------------

bachtocc.exe : bachtocc.obj bachtocc.def
  link bachtocc,, NUL, /nod slibcew libw win87em mmsystem, bachtocc
  rc -t -30 bachtocc.exe

bachtocc.obj : bachtocc.c
  cl -c -G2sw -Ow -W3 -Zp bachtocc.c
```

Figure 1: This is the Make file to use with Microsoft C 6.0 and the Windows Software Development Kit (SDK).

BACHTOCC.BCP — COMPLETE LISTING

```
#-----------------------------------------
# BACHTOCC.BCP make file for Borland C++ 2.0
#-----------------------------------------

bachtocc.exe : bachtocc.obj bachtocc.def
     tlink /c /n /Tw /Lc:\borlandc\lib c0ws bachtocc, bachtocc, NUL, \
           /nod cwins cs import maths mmsystem, bachtocc
     rc -t -30 bachtocc.exe

bachtocc.obj : bachtocc.c
     bcc -c -w-par -W -2 bachtocc.c
```

Figure 2: This is the Make file to use with Borland C++ 2.0.

TRANSLATING MUSIC INTO NUMBERS

The first measure of the Bach Toccata is shown in Figure 5. Our job here is to translate this music into a series of numbers—basically key numbers and timing information that indicate when to send Note On messages (equivalent to an organ key being depressed) and Note Off messages (a key release). Because an organ keyboard is not velocity-sensitive, we are able to play all the notes using the same velocities.

Another way to simplify is to ignore the difference between staccato playing (leaving a slight pause between successive notes for a sharper, crisper effect) and legato playing (a smoother overlapping blend between successive notes). We'll assume that the ending of one note is followed immediately by the beginning of the next.

If you can read music, you'll note that the opening of the Toccata consists of parallel octaves. So I created a data structure in BACHTOCC called noteseq to store a series of note durations and two key numbers. Unfortunately, continuing the music into the second measure would require a more generalized approach to storing this information.

I decided that a quarter note should have a duration of 1,760 milliseconds, which means that an eighth note (one stem on the note or rest) has a duration of 880 milliseconds, a 16th note (two stems) 440, a 32nd note (three stems) 220, and a 64th note (four stems) 110.

There are two *mordants* in this first

BACHTOCC.C — **COMPLETE LISTING**

```
/*-----------------------------------------------------
   BACHTOCC.C -- Bach Toccata in D Minor (First Bar)
                 (c) Charles Petzold, 1992
  -----------------------------------------------------*/

#include <windows.h>
#include <mmsystem.h>

#define ID_TIMER    1

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG) ;

char szAppName[] = "BachTocc" ;

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
                    LPSTR lpszCmdParam, int nCmdShow)
     {
     HWND        hwnd ;
     MSG         msg ;
     WNDCLASS    wndclass ;

     if (!hPrevInstance)
          {
          wndclass.style          = CS_HREDRAW | CS_VREDRAW ;
          wndclass.lpfnWndProc    = WndProc ;
          wndclass.cbClsExtra     = 0 ;
          wndclass.cbWndExtra     = 0 ;
          wndclass.hInstance      = hInstance ;
          wndclass.hIcon          = LoadIcon (NULL, IDI_APPLICATION) ;
          wndclass.hCursor        = LoadCursor (NULL, IDC_ARROW) ;
          wndclass.hbrBackground  = GetStockObject (WHITE_BRUSH) ;
          wndclass.lpszMenuName   = NULL ;
          wndclass.lpszClassName  = szAppName ;

          RegisterClass (&wndclass) ;
          }

     hwnd = CreateWindow (szAppName, "Bach Toccata in D Minor (First Bar)",
                          WS_OVERLAPPEDWINDOW,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          CW_USEDEFAULT, CW_USEDEFAULT,
                          NULL, NULL, hInstance, NULL) ;

     ShowWindow (hwnd, nCmdShow) ;
     UpdateWindow (hwnd) ;

     while (GetMessage (&msg, NULL, 0, 0))
          {
          TranslateMessage (&msg) ;
          DispatchMessage (&msg) ;
          }
     return msg.wParam ;
     }
DWORD MidiOutMessage (HMIDIOUT hMidi, int iStatus, int iChannel,
                                  int iData1,  int iData2)
     {
     DWORD dwMessage ;

     dwMessage = iStatus | iChannel | (iData1 << 8) | ((long) iData2 << 16) ;

     return midiOutShortMsg (hMidi, dwMessage) ;
     }

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
     {
     static struct
          {
          int iDur ;
          int iNote [2] ;
          }
          noteseq [] = {
                        110, 69, 81,  110, 67, 79,  990, 69, 81,  220, -1, -1
                        110, 67, 79,  110, 65, 77,  110, 64, 76,  110, 62, 74,
                        220, 61, 73,  440, 62, 74, 1980, -1, -1,  110, 57, 69,
                        110, 55, 67,  990, 57, 69,  220, -1, -1,  220, 52, 64,
                        220, 53, 65,  220, 49, 61,  440, 50, 62, 1980, -1, -1
                       } ;

     static HMIDIOUT hMidiOut ;
     static int      iIndex ;
     int             i ;

     switch (message)
          {
          case WM_CREATE:
               if (!SetTimer (hwnd, ID_TIMER, 1000, NULL))
                    {
                    MessageBeep (MB_ICONEXCLAMATION) ;
                    MessageBox (hwnd, "Too many clocks or timers!",
                                szAppName, MB_ICONEXCLAMATION | MB_OK) ;

                    DestroyWindow (hwnd) ;
                    return 0 ;
                    }

               if (midiOutOpen (&hMidiOut, MIDIMAPPER, NULL, NULL, 0L))
                    {
                    KillTimer (hwnd, ID_TIMER) ;

                    MessageBeep (MB_ICONEXCLAMATION) ;
                    MessageBox (hwnd, "Cannot open MIDI output device!",
                                szAppName, MB_ICONEXCLAMATION | MB_OK) ;

                    DestroyWindow (hwnd) ;
                    return 0 ;
                    }

                         // Send Program Change messages for "Church Organ"

               MidiOutMessage (hMidiOut, 0xC0,  0, 19, 0) ;
               MidiOutMessage (hMidiOut, 0xC0, 12, 19, 0) ;

               return 0 ;
          case WM_TIMER:
                         // Loop for 2-note polyphony

               for (i = 0 ; i < 2 ; i++)
                    {
                         // Note Off messages for previous note

                    if (iIndex != 0 && noteseq[iIndex - 1].iNote[i] != -1)
                         {
                         MidiOutMessage (hMidiOut, 0x80,  0,
                                         noteseq[iIndex - 1].iNote[i], 0) ;

                         MidiOutMessage (hMidiOut, 0x80, 12,
                                         noteseq[iIndex - 1].iNote[i], 0) ;
                         }

                         // Note On messages for new note

                    if (iIndex != sizeof (noteseq) / sizeof (noteseq[0]) &&
                              noteseq[iIndex].iNote[i] != -1)
                         {
                         MidiOutMessage (hMidiOut, 0x90,  0,
                                         noteseq[iIndex].iNote[i], 127) ;

                         MidiOutMessage (hMidiOut, 0x90, 12,
                                         noteseq[iIndex].iNote[i], 127) ;
                         }
                    }

               if (iIndex != sizeof (noteseq) / sizeof (noteseq[0]))
                    {
                    SetTimer (hwnd, ID_TIMER, noteseq[iIndex++].iDur - 1, NULL);
                    }
               else
                    {
                    midiOutClose (hMidiOut) ;
                    KillTimer (hwnd, ID_TIMER) ;
                    DestroyWindow (hwnd) ;
                    }

               return 0 ;

          case WM_DESTROY:
               PostQuitMessage (0) ;
               return 0 ;
          }

     return DefWindowProc (hwnd, message, wParam, lParam) ;
     }
```

Figure 3: This listing contains all the source code for the program.

measure: one over the very first note and the other halfway through the measure. These are indicated by squiggly lines with a short vertical. In baroque music, the mordant sign means that the note should actually be played as three notes: the indicated note, a note a full tone below it, and then the indicated note. The first two notes should be played quickly, and the third held for the remaining duration. For example, the first note is an A with a mordant. This is played as A, G, A. I decided to make the first two notes of the mordant 64th notes, hence having a duration of 110 milliseconds.

There are also four *fermatas* contained in this first measure. They are indicated by semicircles with dots in the middle. The fermata sign means that the note should be held longer than its notated duration, generally at the player's discretion. For the fermatas, I decided to increase the note durations by 50 percent.

As you can see, translating even a piece of music that sounds as simple as the opening of the D Minor Toccata is not always straightforward.

The noteseq structure array contains three numbers for every parallel note and rest in the measure. The duration of the note is followed by two MIDI key numbers for the parallel octaves. For example, the first note is an A with a duration of

BACHTOCC.DEF COMPLETE LISTING

```
;-------------------------------------
; BACHTOCC.DEF module definition file
;-------------------------------------

NAME            BACHTOCC

DESCRIPTION     'Bach Toccata in D Minor (c) Charles Petzold, 1992'
EXETYPE         WINDOWS
STUB            'WINSTUB.EXE'
CODE            PRELOAD MOVEABLE DISCARDABLE
DATA            PRELOAD MOVEABLE MULTIPLE
HEAPSIZE        1024
STACKSIZE       8192
EXPORTS         WndProc
```

Figure 4: Here is the program's module definition file.

110 milliseconds. Because middle C has a MIDI key number of 60, the A above middle C has a key number of 69, and the A an octave higher has a key number of 81. Thus, the first three values in the noteseq array are 110, 69, and 81. I've used note values of -1 to indicate a rest.

USING THE MIDI MAPPER DEVICE

During the WM_CREATE message, BACHTOCC sets a Windows timer for 1,000 milliseconds—meaning that the music will begin in 1 second—and then calls midiOutOpen using the MIDI-MAPPER device ID. The MIDI Mapper is the only MIDI output device that guarantees reasonable device independence. But there are some complications.

As I discussed two columns ago, MIDI supports 16 channels. At any one time, each channel can be associated with a particular instrument voice by sending a Program Change message for that channel. Subsequent Note On messages for that channel play notes using that instrument voice. Thus, in theory, a single MIDI cable or synthesizer can support 16 different simultaneous voices. You can think of this as a 16-piece band, one piece per channel.

However, not all synthesizers are capable of 16 different simultaneous instrument voices. In the last issue, I discussed how Multimedia Windows defines two broad categories of MIDI synthesizer: A *base-level* synthesizer is capable of 3 simultaneous melodic voices with 6-note polyphony, and a percussion voice with 3-note polyphony. An *extended* synthesizer is capable of 9 simultaneous melodic voices with 16-note polyphony, and a percussion voice, also with 16-note polyphony.

In order to accommodate support for both base-level and extended synthesizers when using MIDI, Multimedia Windows assigns distinct channel numbers for the two categories of synthesizers. Channels 0 through 9 are reserved for an extended synthesizer, with the melodic voices on channels 0 through 8 and the percussion voice on channel 9. Channels 12 through 15 are reserved for a base-level synthesizer, with the melodic voices on channels 12 through 14 and the percussion voice on channel 15. (I'm assuming the channel numbering begins with 0, because that's the way the MIDI messages are structured. In some MIDI documentation, channel numbering is 1-based.)

So now we seem to have a problem. If you open the MIDI Mapper output device, how can you tell whether you're playing on a base-level or extended synthesizer? In short, what channels do you use? The answer is actually quite simple: You assume that you're playing *both* a base-level synthesizer and an extended synthesizer, and send duplicate messages.

For example, BACHTOCC requires only one instrument voice (an organ) so in theory it needs to use only one channel. But all Program Change, Note On, and Note Off messages in BACHTOCC are duplicated and sent over two channels: channel 0 for an extended synthesizer and channel 12 for a base-level synthesizer. The MIDI Mapper handles the rest. If you've specified an extended synthesizer in the Control Panel MIDI Mapper utility, only MIDI messages for channels numbered 0 through 9 are passed to the synthesizer. MIDI messages for channels 10 through 15 are discarded. If you've specified a base-level synthesizer in the MIDI Mapper utility, MIDI messages for channels 12 through 15 are passed to the synthesizer, and messages for channels 0 through 11 are discarded.

So, even though you duplicate MIDI messages using channels associated with both a base-level and an extended synthesizer, only the channel data for the particular selected synthesizer will be accepted by the MIDI Mapper.

SENDING MIDI MESSAGES

To simplify the sending of MIDI messages, I've defined a short function in BACHTOCC called MidiOutMessage. This function accepts a MIDI output handle, a status byte, a channel number, and 2 bytes of data. It assembles these numbers into a packed 32-bit message and calls midiOutShortMsg.

At the end of WM_CREATE processing, BACHTOCC sends two Program Change messages to select the "church organ" voice. In the General MIDI Mode voice assignments, the church organ voice is indicated by a data byte of 19 in the Program Change message. This Program Change message is sent on both channels 0 (for an extended synthesizer) and 12 (for a base-level synthesizer).

If the actual synthesizer in use does not use the General MIDI Mode voice mapping, then voice 19 may not correspond to a church organ. In this case, the MIDI Mapper translates the voice number to select a church organ sound on the synthesizer. For example, if you have a Roland MT-32 external synthesizer, then the MIDI Mapper translates this Program Change message to select voice 13, which corresponds to one of the pipe organ sounds on the MT-32.

The actual playing of notes occurs during the WM_TIMER message. A loop handles the two-note polyphony. If a previous note is still playing, BACHTOCC sends Note Off messages for that note, again on channels 0 and 12. Then, if the new note is not a rest, it sends Note On messages to channels 0 and 12. It then resets the Windows timer to the duration of the note indicated in the noteseq structure.

When the music concludes, BACHTOCC closes the MIDI output device by calling midiOutClose, and destroys the window, terminating the program.

This technique of sending dual messages is only valid when you open the MIDI Mapper output device. If you open one of the real MIDI devices, this approach doesn't make any sense. You may end up playing two organs rather than just one! Moreover, if the MIDI synthesizer does not conform to the General

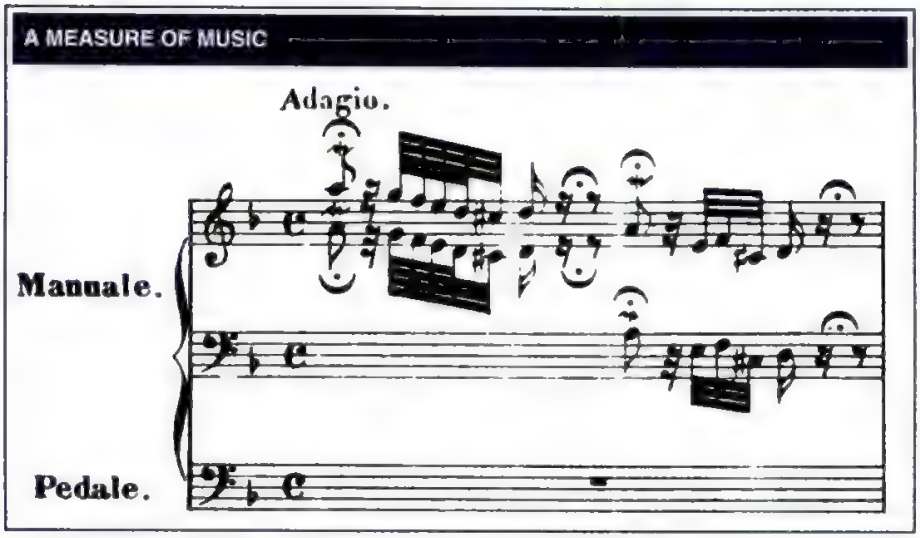

Figure 5: The BACHTOCC program plays the first measure of the toccata section of Bach's "Toccata and Fugue in D Minor" for organ.

MIDI Mode voice assignments, it may not even sound like an organ. For example, if you have a Roland MT-32, voice 19 corresponds to a clavichord, and that's what you'll hear.

HANDLING LONG MESSAGES

So we see now how the MIDI interface of Multimedia Windows offers a large degree of device independence. But this is only guaranteed when you open the MIDI Mapper device. If you open one of the real devices, you should use midiOutGetDevCaps to determine which synthesizer you're dealing with and then deal with it appropriately.

Device independence is great, but it would be a shame if Multimedia Windows were so restrictive that it disallowed many of the feats possible when directly accessing the MIDI hardware. As I discussed in my March 17, 1992, column, many MIDI synthesizers respond to *system exclusive* messages, also called *long messages.* These messages can be used to configure a synthesizer in different ways, for example, by loading different instrument voice data into it.

To use long messages, you must know precisely what type of synthesizer you're dealing with. Each synthesizer manufacturer defines its own system exclusive messages, because different synthesizers use different types of note-generation techniques and are capable of different nonstandard features.

Because long messages can be quite long, handling them under Multimedia Windows is very similar to handling low-level waveform audio output. Basically you allocate a global memory block to hold the long message (or part of it), set up a MIDIHDR structure, pass the structure to the midiOutPrepareHeader function and then to midiOutLongMsg. The actual transfer of the long message to the synthesizer occurs in the background. You are notified of the transfer's completion by a message to your program's window procedure or a call to a function in a dynamic link library (DLL).

This is the purpose of the last three parameters to midiOutOpen. The third parameter specifies either a window handle or a DLL callback function, and the last parameter is set to either CALLBACK_WINDOW or CALLBACK_FUNCTION. The fourth parameter to midiOutOpen is program-defined data that can be passed to the DLL callback function.

THE TIMER PROBLEM

Although BACHTOCC works, and the results sound reasonable (if not exactly like a human being playing), using the Windows timer for playing music in this way simply does not work in the general case.

The problem is that the Windows timer is based on the PC's system clock, and it only has a resolution of about 55 milliseconds (actually closer to 54.925 milliseconds). That's why all the note durations in noteseq are increments of 55 milliseconds. (Because of the way in which the Windows timer translates time increments to timer ticks, 1 is subtracted from each of these duration values when calling SetTimer.)

The PC system clock is configured for approximately 18.2 timer ticks per second, and you can only receive WM_TIMER messages based on these timer ticks. Suppose you want to play a piece of music at a common tempo of one quarter note per second. You can't do it exactly. The closest you can get is 18 timer ticks per quarter note, or about 989 milliseconds. An eighth note would be half that, or 9 timer ticks in duration, and a 16th note would be. . . well, 4½ timer ticks and that's impossible. You'd have to make it either 4 or 5, and you'd be off a little. Is the ear capable of detecting this slight a difference? For music, you better believe it, and it gets even worse if the errors begin accumulating over time.

Moreover, the Windows timer is not asynchronous. There may be slight delays in getting WM_TIMER messages if another program is busy doing something. WM_TIMER messages could even be discarded if the program can't handle them immediately. It could start sounding like a real mess.

So, while BACHTOCC shows how to call the low-level MIDI output functions, using the Windows timer is clearly inadequate for accurate music reproduction.

That's why Multimedia Windows includes a supplementary set of timer functions you can take advantage of when using the low-level MIDI output functions. These functions begin with the prefix *time,* and you can use them to set a timer with a resolution as low as 1 millisecond. The catch is that processing this timer must be handled in a callback function in a dynamic link library, because the callback function is called during hardware interrupt time. Moreover, the Windows functions that may be called in this callback function are severely limited; basically you can only call the timer functions, PostMessage, midiOutShortMsg, and midiOutLongMsg.

Using a dynamic link library obviously complicates things, but I'll probably tackle it in a future column.

In the next issue I'll discuss a program where low-level MIDI output functions are called in response to keyboard messages without using the timer at all. This program lets you play a MIDI synthesizer from your PC keyboard, with complete control over the MIDI device, the channel, and the instrument voice. ■

by
Ray Duncan

Power Programming

Building A Pen-Centric Application For Pen Windows

Microsoft Windows for Pen Computing (Pen Windows) is a rich and flexible platform for the development of pen-oriented applications, yet adapting an existing Windows program for Pen Windows is not necessarily a grueling, painful experience. If you opt for the most minimal conversion, you can simply add a check for the presence of Pen Windows and a call to the API function RegisterPenApp() in your application's initialization code, and all EDIT controls within the program's dialog boxes will be automatically transformed to HEDIT (handwriting edit) controls.

The user can either type or write within an HEDIT control; handwritten input is translated transparently to WM_CHAR messages so it looks just like keyboard input to the application. With a small amount of additional effort, you can make your application much more friendly to the pen computer user by replacing the HEDIT controls with BEDIT controls: input areas that are divided into character cells by a *comb* to provide the user with additional visual cues and improve the accuracy of the recognition process.

Once you venture beyond the RegisterPenApp() function and the HEDIT and BEDIT controls, you are developing an application that is pen-centric rather than merely pen-aware. There are many aspects to pen-centricity, some of which (such as custom dictionaries) we've already discussed, but the two fundamental Pen Windows API functions you need to understand at this point are ProcessWriting() and Recognize().

TWO FUNDAMENTAL FUNCTIONS

ProcessWriting() and Recognize() are two of the most sophisticated, complex functions in the entire Windows API, but they are not difficult to use. An application typically calls one of these functions when it detects a pen-down event (passed to the program by Pen Windows as an ordinary WM_LBUTTONDOWN message) within the writing area. The functions collect the handwritten input, segment the writing into individual glyphs, translate the glyphs into characters or gestures, and then return control to the calling program.

> ■ A sample program illustrates some of the essential features of a pen-centric application, and demonstrates the important functions used to create it.

ProcessWriting() and Recognize() can detect completion of a handwritten entry in any of several ways; for example, the user might tap the pen outside the writing area, or might simply lift the pen and allow a predetermined time-out period to elapse. Let's look at each of these functions in more detail now.

ProcessWriting() is called with two parameters: a window handle and a far pointer to an RC (Recognition Context) data structure (see the explanation of the RC structure in the March 17, 1992, column). If the pointer to the RC data structure is NULL, the system supplies an RC structure with default values and uses the client area of the specified window as the writing area. When the written input is completed, ProcessWriting() translates the ink into a symbol graph that encodes all of the possible translations of the ink, removes the ink from the writing area, and sends a WM_RCRESULT message to the application. This message includes a far pointer to an RCRESULT structure that contains various information about the translated input, as shown in Figure 1.

If the application ignores the WM_RCRESULT message, as it is free to do, the system will derive the string that represents the most likely translation of the input from the symbol graph and send the string to the application as a series of individual WM_CHAR messages. Gestures are translated into cut, copy, paste, backspace, and similar operations and sent to the application as WM_*xxxx* messages in a similar manner. The ProcessWriting() function then returns a status code indicating the mode of input completion or an error condition.

Recognize() is very similar to ProcessWriting(), but assumes that the program wants to control the handwritten input process at a much more basic level. The only parameter to Recognize() is a far pointer to an RC data structure, which must have been previously allocated and initialized by the application. (Initialization of the RC's many fields can be most easily accomplished with the aid of the Pen Windows function InitRC(), which fills in the RC with the system-wide default values).

Recognize() collects the handwritten input, translates it to a symbol graph, sends a pointer to the RCRESULT structure in a WM_RCRESULT message, and then finally returns a completion mode or error code—just like ProcessWriting(). The crucial differences between Recognize() and ProcessWriting() are that, first, Recognize() does not remove the ink from the writing area, and second, Recognize() does

not translate the input into conventional WM_CHAR and other messages if the application chooses not to process the WM_RCRESULT message.

An application can manipulate the contents of the RC data structure that it supplies to ProcessWriting() or Recognize() in order to assert extremely detailed control over the input and recognition process. For example, the application can specify that the results of the input will be sent as messages to a different window than the one that is being used as a writing area; it can control the level of *chunking* that will be used in results messages (strings, words, characters, or even individual pen strokes); it can fine-tune the location and size of the writing input area; it can limit the recognizer's translation to a specific set of characters; it can change the time-out interval; and it can designate from 1 to 16 dictionary modules that will be called by the recognizer to assist in the translation process. The end user can configure some of the default values in the RC structure via the Pen Windows Control Panel, but the application is able to override them.

AN EXAMPLE

In order to demonstrate the use of the Pen Windows Recognize() function and illustrate some of the essential features of a pen-centric application, I've written an example program called DEMO6.EXE. The C language source code for the program can be found in Figure 2, the header file in Figure 3, and the module definition file, which declares the program's module name, segment attributes, heap size, and other important characteristics for the linker, in Figure 4. The resource script file, which defines the application's menu bar, is shown in Figure 5. You can download all the source files for DEMO6.EXE, as well as the executable file, from the Programmer's Forum on PC MagNet.

From the user's point of view, DEMO6 presents a normal frame window with a title bar, resizable border, system menu, and a menu bar containing a single pop-up menu—File—which in turn has a single item—Exit. The client area of the frame window is divided vertically into two sections of equal size: a writing input area on the left, and a text output area on the right. When the user clicks the pen inside the writing area, both the input and output areas are erased, and collection of pen input begins. The stages of the input process, and the results returned to the application in the WM_RCRESULT message, are listed in the text output window.

The overall structure of the source code for DEMO6 is quite similar to the programs DEMO1 through DEMO5 that I discussed in the last three issues. The WinMain() function of DEMO6 is just like all of our other demo programs and needs no further discussion. The InitApplication() and InitInstance() functions look pretty familiar too, except that InitApplication() registers two child window classes in addition to the class used for the application's frame window. The DoCommand() function is even simpler than its predecessors, because it only has to handle a single menu item: File-Exit!

The DisplayLine() function is called to scroll the text output window and display a string at the bottom of the window, and two tables—recResults[] and rctypeResults[]—are used to associate the binary values of certain Pen Windows recognition flags and status codes with descriptive strings for display purposes.

Four callback functions, FrameWndProc(), TextWndProc(), WriteWndProc(), and EnumFunc(), form the heart of DEMO6's functionality, and it is this code you should study most closely. FrameWndProc() processes all Windows messages directed to the application's main or frame window. The most important part of this function is the code that handles the WM_CREATE and WM_SIZE messages.

The WM_CREATE message is received when the InitInstance() routine calls the Windows function CreateWindow() to create the frame window. (In fact, FrameWndProc()'s processing of the WM_CREATE message occurs "inside" the CreateWindow() function; CreateWindow() doesn't return to InitInstance() until FrameWndProc() has been called by the Windows kernel with the WM_CREATE message and has returned.) FrameWndProc() acts upon the WM_CREATE message by calling CreateWindow() twice more to create two child windows for writing input and text output.

During processing of the WM_SIZE message, which is received immediately after WM_CREATE and again whenever the user resizes the window, FrameWndProc() determines the current dimensions of the frame window's client area, and adjusts the sizes and positions of the writing input and text output child windows to occupy the left and right halves of the client area respectively.

The WriteWndProc() callback func-

THE RCRESULT DATA STRUCTURE

Field	Significance
rcresult.syg	Embedded symbol graph (SYG) structure, which contains (among other things) a far pointer to the actual symbol graph and the stroke data that corresponds to each symbol.
rcresult.wResultsType	Flags indicating whether the symbol graph corresponds to characters or gestures, or nothing was recognized.
rcresult.cSyv	Count of recognized symbols.
rcresult.lpSyv	Far pointer to the symbol string that is the preferred translation of the symbol graph.
rcresult.hSyv	Handle for global shared memory containing the symbol string pointed to by rcresult.lpSyv.
rcresult.nBaseLine	Baseline of input writing.
rcresult.nMidLine	Midline of input writing.
rcresult.hpendata	Handle for the original raw pen data captured during recognition.
rcresult.rectBoundInk	The bounding rectangle of the ink captured during recognition.
rcresult.pntEnd	Coordinates of the point tapped outside the writing area to end the recognition process, if any.
rcresult.lprc	Far pointer to the RC data structure used during recognition.

Figure 1: These are the fields of the RCRESULT data structure, which is used by the Pen Windows ProcessWriting() and Recognize() API functions to pass the results of handwritten input to a pen-aware or pen-centric application.

DEMO6.C


```
// DEMO6.C --- Pen-centric Windows application that demonstrates
// handwritten input using the Recognize() function.
// Copyright (C) 1992 Ray Duncan

#define WIN31
#define dim(x) (sizeof(x) / sizeof(x[0]))    // returns no. of elements
#define BUFMAX 80                            // size of scratch buffers

#include "windows.h"
#include "penwin.h"
#include "demo6.h"

HANDLE hInst;                                // instance handle
HWND hWndFrame = 0;                          // frame window handle
HWND hWndText = 0;                           // child text window handle
HWND hWndWrite = 0;                          // child writing window handle
HANDLE hPenWin = 0;                          // Pen Windows module handle

int CharX = 0;                               // average char width
int CharY = 0;                               // char height
int EnumCount = 0;                           // translation counter

char szFrameClass[] = "DemoFrameClass";      // name of frame window class
char szTextClass[]  = "DemoTextClass";       // child text window class
char szWriteClass[] = "DemoWriteClass";      // child writing window class

struct {                                     // result codes returned
    int Code;                                // by Recognize() function
    char * Name;
    } recogResults[] = {
    REC_OK, "REC_OK",
    REC_ABORT, "REC_ABORT",
    REC_BADHPENDATA, "REC_BADHPENDATA",
    REC_BUFFERTOOSMALL, "REC_BUFFERTOOSMALL",
    REC_BUSY, "REC_BUSY",
    REC_DONE, "REC_DONE",
    REC_NOINPUT, "REC_NOINPUT",
    REC_NOTABLET, "REC_NOTABLET",
    REC_OOM, "REC_OOM",
    REC_OVERFLOW, "REC_OVERFLOW",
    REC_TERMBOUND, "REC_TERMBOUND",
    REC_TERMEX, "REC_TERMEX",
    REC_TERMOEM, "REC_TERMOEM",
    REC_TERMPENUP, "REC_TERMPENUP",
    REC_TERMRANGE, "REC_TERMRANGE",
    REC_TERMTIMEOUT, "REC_TERMTIMEOUT", } ;

struct {                                     // result types returned
    int Code;                                // in RCRESULT structure
    char * Name;
    } rctypeResults[] = {
    RCRT_UNIDENTIFIED, "RCRT_UNIDENTIFIED",
    RCRT_GESTURE, "RCRT_GESTURE",
    RCRT_NOSYMBOLMATCH, "RCRT_NOSYMBOLMATCH",
    RCRT_PRIVATE, "RCRT_PRIVATE",
    RCRT_NORECOG, "RCRT_NORECOG",
    RCRT_ALREADYPROCESSED, "RCRT_ALREADYPROCESSED",
    RCRT_GESTURETRANSLATED, "RCRT_GESTURETRANSLATED",
    RCRT_GESTURETOKEYS, "RCRT_GESTURETOKEYS", } ;

//
// WinMain --- entry point from Windows.  Registers window classes,
// creates windows, registers pen app, and processes messages until
// WM_QUIT received.
//
int PASCAL WinMain(HANDLE hInstance,
    HANDLE hPrevInstance, LPSTR lpCmdLine, int nCmdShow)
{
    MSG msg;

    hInst = hInstance;                       // save this instance handle

    if(!hPrevInstance)                       // if first instance,
        if(!InitApplication(hInstance))      // register window class
            return(FALSE);                   // exit if couldn't register

    if(!InitInstance(hInstance, nCmdShow))   // create this instance's window
    {
        MessageBox(0, "Initialization failed!", "DEMO6", MB_OK|MB_ICONSTOP);
        return(FALSE);
    }

    RegisterPenApp(RPA_DEFAULT, TRUE);       // enable HEDIT/BEDIT controls

    while(GetMessage(&msg, NULL, 0, 0))      // while message != WM_QUIT
    {
        TranslateMessage(&msg);              // translate virtual key codes
        DispatchMessage(&msg);               // dispatch message to window
    }
    return(msg.wParam);                      // return code = WM_QUIT value
}

//
// InitApplication --- registers window classes for this application
//
BOOL InitApplication(HANDLE hInstance)
{
    WNDCLASS  wc;
    BOOL bParent;
    BOOL bText;
    BOOL bWrite;

    // set parameters for frame window class
    wc.style = CS_HREDRAW | CS_VREDRAW;      // class style
    wc.lpfnWndProc = FrameWndProc;           // class callback function
    wc.cbClsExtra = 0;                       // extra per-class data
    wc.cbWndExtra = 0;                       // extra per-window data
    wc.hInstance = hInstance;                // handle of class owner
    wc.hIcon = LoadIcon(NULL, IDI_APPLICATION);      // default icon
    wc.hCursor = LoadCursor(NULL, IDC_ARROW);        // default cursor
    wc.hbrBackground = GetStockObject(WHITE_BRUSH); // background color
    wc.lpszMenuName =  "DemoMenu";           // name of menu resource
    wc.lpszClassName = szFrameClass;         // name of window class

    bParent = RegisterClass(&wc);            // register frame window class

    // set parameters for text output child window class
    wc.lpfnWndProc = TextWndProc;            // class callback function
    wc.hIcon = NULL;                         // default icon
    wc.lpszMenuName =  NULL;                 // name of menu resource
    wc.lpszClassName = szTextClass;          // name of window class

    bText = RegisterClass(&wc);              // register text child class

    // set parameters for writing input child window class
    wc.lpfnWndProc = WriteWndProc;           // class callback function
    wc.lpszClassName = szWriteClass;         // name of window class

    bWrite = RegisterClass(&wc);             // register writing child class

    return(bParent && bText && bWrite);      // return success/failure flag
}

//
// InitInstance --- creates frame window for this application instance
//
BOOL InitInstance(HANDLE hInstance, int nCmdShow)
{
    hWndFrame = CreateWindow(                // create frame window
        szFrameClass,                        // window class name
        "Pen Windows Demo #6",               // text for title bar
        WS_OVERLAPPEDWINDOW,                 // window style
        CW_USEDEFAULT, CW_USEDEFAULT,        // default position
        CW_USEDEFAULT, CW_USEDEFAULT,        // default size
        NULL,                                // no parent window
        NULL,                                // use class default menu
        hInstance,                           // window owner
        NULL                                 // unused pointer
    );

    if(!hWndFrame) return(FALSE);            // error, can't create window

    ShowWindow(hWndFrame, nCmdShow);         // make frame window visible
    UpdateWindow(hWndFrame);                 // force WM_PAINT message
    return(TRUE);                            // return success flag
}

//
// FrameWndProc --- callback function for application frame window
//
long FAR PASCAL FrameWndProc(HWND hWnd, WORD wMsg, WORD wParam, LONG lParam)
{
    switch (wMsg)
    {
        case WM_CREATE:                      // creating frame window
            hWndText = CreateWindow(         // create child text window
                szTextClass,                 // window class name
                NULL,                        // text for title bar
                WS_CHILDWINDOW | WS_VISIBLE | WS_BORDER,    // style
                0, 0, 0, 0,                  // position and size
                hWnd,                        // frame window is parent
                0,                           // child window identifier
                hInst,                       // window owner
                NULL);                       // unused pointer
            hWndWrite = CreateWindow(        // create child writing window
                szWriteClass,                // window class name
                NULL,                        // text for title bar
                WS_CHILDWINDOW | WS_VISIBLE | WS_BORDER,    // style
                0, 0, 0, 0,                  // position and size
                hWnd,                        // frame window is parent
                0,                           // child window identifier
                hInst,                       // window owner
                NULL);                       // unused pointer
            break;

        case WM_SIZE:                        // resize & position children:
            MoveWindow(hWndWrite,            // writing input window
                0, 0, LOWORD(lParam)/2, HIWORD(lParam), TRUE);
            MoveWindow(hWndText,             // text output window
                LOWORD(lParam)/2, 0, LOWORD(lParam), HIWORD(lParam), TRUE);
            return(0);

        case WM_COMMAND:                     // menu command received,
            DoCommand(hWnd, wParam);         // decode it
            break;

        case WM_DESTROY:                     // window being destroyed
            PostQuitMessage(0);              // force WM_QUIT message
            break;

        default:                             // let Windows handle it
            return(DefWindowProc(hWnd, wMsg, wParam, lParam));
    }

    return(0);
}

//
// TextWndProc --- callback function for child text window
```

Figure 2: This is the source code for a simple pen-centric application.

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DEMO6.C 2 OF 2

```
//
long FAR PASCAL TextWndProc(HWND hWnd, WORD wMsg, WORD wParam, LONG lParam)
{
    TEXTMETRIC tm;
    HDC hdc;
    LPRCRESULT rcresult;                    // recognition results
    FARPROC lpProc;                         // far pointer for callback
    char buff1[BUFMAX];                     // scratch buffer
    char buff2[BUFMAX];                     // scratch buffer
    int i;                                  // scratch variable

    switch(wMsg)
    {
        case WM_CREATE:                     // creating text child window
            hdc = GetDC(hWnd);              // get device context
            GetTextMetrics(hdc, &tm);       // get text metrics
            CharX = tm.tmAveCharWidth;      // save character size
            CharY = tm.tmHeight + tm.tmExternalLeading;
            ReleaseDC(hWnd, hdc);           // release device context
            return(0);

        case WM_RCRESULT:                   // display recognition results
            rcresult = (LPRCRESULT) lParam; // get pointer to results
            DisplayLine("Message WM_RCRESULT received.");
            for(i = 0; i < dim(rctypeResults); i++)
            {                               // decode result type
                if(rctypeResults[i].Code & rcresult->wResultsType)
                {
                    wsprintf(buff1, "Result type code: %s.",
                        (LPSTR) rctypeResults[i].Name);
                    DisplayLine(buff1);     // display result type
                }
            }
            SymbolToCharacter(rcresult->lpsyv, BUFMAX, buff2, NULL);
            wsprintf(buff1, "Preferred translation is: %s.", (LPSTR) buff2);
            DisplayLine(buff1);             // display best bet string
            wsprintf(buff1, "Symbol graph has %d possible translations.",
                GetSymbolCount(&(rcresult->syg)));
            DisplayLine(buff1);             // display no. of candidates
            EnumCount = 0;                  // display each candidate
            lpProc = MakeProcInstance(EnumFunc, hInst);
            EnumSymbols(&(rcresult->syg), 1000, lpProc, NULL);
            FreeProcInstance(lpProc);
            return(0);

        default:
            return(DefWindowProc(hWnd, wMsg, wParam, lParam));
    }
}

//
// WriteWndProc --- callback function for child writing window
//
long FAR PASCAL WriteWndProc(HWND hWnd, WORD wMsg, WORD wParam, LONG lParam)
{
    RC rc;                                  // recognition context
    HDC hdc;                                // device context handle
    PAINTSTRUCT ps;                         // painting info structure
    RECT rect;                              // receives client rectangle
    REC result;                             // status from Recognize()
    char buff1[BUFMAX];                     // scratch buffer
    int i;                                  // scratch variable

    switch(wMsg)
    {
        case WM_PAINT:                      // window needs repainting
            hdc = BeginPaint(hWnd, &ps);    // get device context
            GetClientRect(hWnd, &rect);     // get client rectangle
            DrawText(hdc,                   // put legend in writing area
                "Writing Area", -1, &rect,
                DT_CENTER | DT_TOP | DT_SINGLELINE);
            EndPaint(hWnd, &ps);            // release device context
            break;

        case WM_LBUTTONDOWN:                // mouseclick starts pen input
            if(IsPenEvent(wMsg, GetMessageExtraInfo()))
            {
                InvalidateRect(hWnd, NULL, TRUE);   // erase both windows
                UpdateWindow(hWnd);
                InvalidateRect(hWndText, NULL, TRUE);
                UpdateWindow(hWndText);
                DisplayLine("Initializing RC structure.");
                InitRC(hWndWrite, &rc);     // set default RC values
                rc.hwnd = hWndText;         // text window gets results
                rc.rglpdf[0] = NULL;        // assume no dictionary
                DisplayLine("Calling Recognize function.");
                result = Recognize(&rc);    // request pen input
                strcpy(buff1, "Recognize result code: unknown.");
                for(i = 0; i < dim(recogResults); i++)
                {                           // decode Recognize() status
                    if(recogResults[i].Code == result)
                        wsprintf(buff1, "Recognize result code: %s.",
                            (LPSTR) recogResults[i].Name);
                }
                DisplayLine(buff1);         // display Recognize() status
            };
            return(0);

        default:
            return(DefWindowProc(hWnd, wMsg, wParam, lParam));
    }
}

//
// DisplayLine --- displays a string in the text output child window
//
void DisplayLine(char * szOut)
{
    RECT rect;
    HDC hdc;

    hdc = GetDC(hWndText);                  // get device context
    GetClientRect(hWndText, &rect);         // get client rectangle
    ScrollWindow(hWndText, 0, -CharY,       // scroll text window up
        NULL, NULL);
    UpdateWindow(hWndText);
    TextOut(hdc, 0, rect.bottom - CharY,    // display text in window
        szOut, strlen(szOut));
    ReleaseDC(hWndText, hdc);               // release device context
    return;
}

//
// DoCommand --- handles menu command messages for the frame window
//
void DoCommand(HWND hWnd, WORD wParam)
{
    FARPROC lpProc;                         // far pointer to callback

    switch(wParam)                          // decode it
    {
        case IDM_EXIT:                      // user picked File-Quit
            SendMessage (hWnd, WM_CLOSE, 0, 0L);
            break;

        default:                            // unknown command, ignore it
            break;
    }
}

//
// EnumFunc --- the callback function for EnumSymbols().  During
// evaluation of a symbol graph, this function is entered
// repetitively with a pointer to each candidate symbol array.
// The symbol array is translated to a character string and displayed.
//
int FAR PASCAL EnumFunc(LPSYV lpSyv, int cSyv, VOID FAR * lpData)
{
    char buff1[BUFMAX];                     // scratch buffer
    char buff2[BUFMAX];                     // scratch buffer

    SymbolToCharacter(lpSyv, BUFMAX, buff2, NULL);
    wsprintf(buff1, "Translation #%d is: %s.", ++EnumCount, (LPSTR) buff2);
    DisplayLine(buff1);
    return(TRUE);                           // TRUE to continue enumeration
}
```

tion processes messages that are destined for the writing input child window. This function acts on only two messages: WM_PAINT and WM_LBUTTONDOWN; all other messages are passed to the Windows function DefWindowProc() for default processing. The WM_PAINT message is used by WriteWndProc() as a signal to display the text "Writing Area" at the top center of the writing input window. Arrival of the WM_LBUTTONDOWN message indicates that the pen has touched down somewhere within the writing area and that DEMO6 must accept handwritten input from the user.

WriteWndProc()'s response to WM_LBUTTONDOWN is to erase both child windows by calling InvalidateRect() and UpdateWindow(), initialize an RC data structure with InitRC(), put the handle of the text output window into the rc.hwnd field of the RC structure (so that the text output window's callback function receives the results of the handwritten input), and call Recognize(). Each of these steps is audited in the text output window, as is the status code returned by Recognize().

TextWndProc() is entered from Windows with messages that are intended for the text output child window. The message WM_RCRESULT is received by TextWndProc() when the handwritten input has been acquired and translated but before the Recognize() function has returned to WriteWndProc(). TextWndProc() processes the WM_RCRESULT message by extracting the pointer to the RCRESULT structure from the message, displaying the result type code (if any), translating the preferred symbol string pointed to by the RCRESULT structure into an ANSI character string and displaying it, and displaying the number of possible translations of the symbol graph. TextWndProc() then calls the Pen Windows API function

EnumSymbols() to enumerate the candidate symbol strings represented by the symbol graph.

The callback function EnumFunc() receives control at least once and possibly many times inside the execution of a single call to EnumSymbols() by TextWndProc(). Windows calls EnumFunc() once for each candidate symbol string, passing a far pointer to the string and the number of symbols in the string. EnumFunc() uses the Pen Windows API function SymbolToCharacter() to convert the symbol string to an ANSI character string and displays the string in the text output window. This enumeration technique, where a special application callback function is called asynchronously and repetitively to process a list of items whose size can't be predicted in advance, is used often in Windows, and in particular it's a technique you'll have to master if you want to deal with Windows text fonts.

DICTIONARY UPDATE

A few days before I finished this column, Microsoft shipped the "final beta" of the retail Microsoft Windows 3.1 package, the Windows 3.1 Software Development Kit (SDK), and the Pen Windows SDK. The Pen Windows installation program, programming interface, standard gestures, and sample applications have all changed once again in this final beta release, but luckily none of these changes has broken any of the Pen Windows programs published in this column to date. If you're thinking about implementing custom dictionaries as we discussed in the last issue, you should be aware that Microsoft has defined several new dictionary commands or messages:

- DIRQ_COPYRIGHT signals the dictionary to return a copyright string that can be displayed or inspected by the client application; all dictionaries must support this command.
- DIRQ_INIT is sent to the dictionary by the recognition context manager before the dictionary is called with DIRQ_SYMBOL, DIRQ_STRING, or DIRQ_SUGGEST messages during the processing of handwritten input. The dictionary can take this opportunity to load default word lists or perform other per-client initialization.
- DIRQ_CLEANUP is sent to the dictionary before a client application terminates. The dictionary is able to maintain a counter based on the DIRQ_INIT and DIRQ_CLEANUP messages to track the number of simultaneous clients and determine when it is about to be unloaded from memory.

There are also some significant enhancements in the final Pen Windows beta. The character and gesture trainer modules have been revamped, a new "selection gesture" involving a tap-and-hold of the pen has been defined, and an API has been added so applications can activate the on-screen keyboard directly.

Pen Windows systems can now support a pen and a mouse simultaneously. The display can be rotated and reoriented on the fly, and a new applet has been supplied as part of the package to put this capability under the user's control. Custom controls have been developed that will allow you to write pen-aware or pen-centric applications in Visual Basic in a fraction of the time required to design and debug such applications in C.

In short, it looks like everything is on track for an early spring rollout of the official Pen Windows, and several extremely nifty pen computers from major OEMs are waiting in the wings for that event. This will be an exciting year for anyone interested in pen-based computing!

THE IN-BOX

Please send your questions, comments, and suggestions to me at any of the following electronic mail addresses:
PC MagNet: 72241,52
MCI Mail: rduncan
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DEMO6.H — COMPLETE LISTING

```
#define IDM_EXIT  100

int PASCAL WinMain(HANDLE, HANDLE, LPSTR, int);
BOOL InitApplication(HANDLE);
BOOL InitInstance(HANDLE, int);
long FAR PASCAL FrameWndProc(HWND, unsigned, WORD, LONG);
long FAR PASCAL TextWndProc(HWND, unsigned, WORD, LONG);
long FAR PASCAL WriteWndProc(HWND, unsigned, WORD, LONG);
int  FAR PASCAL EnumFunc(LPSYV, int, VOID FAR *);
void DoCommand(HWND, WORD);
void DisplayLine(char *);
```

Figure 3: Here is the C language header file for DEMO6.C.

DEMO6.DEF — COMPLETE LISTING

```
;
; DEMO6.DEF - Module definition file for DEMO6.C
;
NAME            demo6
DESCRIPTION     'Demo Program #6'
EXETYPE         WINDOWS
STUB            'WINSTUB.EXE'
CODE            PRELOAD MOVEABLE DISCARDABLE
DATA            PRELOAD MOVEABLE MULTIPLE
HEAPSIZE        1024
STACKSIZE       8192
EXPORTS
  FrameWndProc
  TextWndProc
  WriteWndProc
  EnumFunc
```

Figure 4: This is the module definition file for DEMO6.C. This file defines the example program's module name, code and data segment characteristics, heap size, and other information used by the linker.

DEMO6.RC — COMPLETE LISTING

```
#include "windows.h"
#include "demo6.h"

DemoMenu MENU
BEGIN
  POPUP "&File"
    BEGIN
      MENUITEM "E&xit",   IDM_EXIT
    END
END
```

Figure 5: Here is the resource script file for DEMO6. This file is compiled by the Resource Compiler and merged into the file produced by the linker to produce the executable Windows application DEMO6.EXE.

by
Sal Ricciardi

Databases

- CLEANER CODE WITH SCRIPTVIEW: Document your PAL programs with ScriptView.
- FIELDSQUEEZE IN PARADOX: Suppressing extra blank spaces in *Paradox* reports.

CLEANER CODE WITH SCRIPTVIEW

Working with PAL (*Paradox* Application Language) scripts submitted to this column by various people can be confounding at times. After all, I really don't understand why everybody doesn't format source code the same way I do! ScriptView, a utility for PAL programmers, makes working with source code much easier, whether it's your own or someone else's. The product formats your scripts and creates a variety of reports, including graphical action diagrams (as shown in Figure 1), variable cross-references, procedure-call tree diagrams, and procedure-call reports. The reports can optionally be output to a comma-delimited file, which can then be imported into a *Paradox* table for custom analysis.

ScriptView's user interface will be familiar to *Paradox* programmers, since it uses *Paradox*-style menus and familiar options such as Do_It to initiate actions. You can tell ScriptView to format and indent your scripts, convert keywords to uppercase, convert variables to lowercase, and even generate commands to create and update *Paradox* procedure libraries.

The action diagrams can be customized to produce full detail or a collapsed view, and can be useful for spotting structural errors in your code. In addition, you can add line numbers to the output and can specify that ScriptView use ASCII characters for the diagrams instead of IBM graphics characters if your printer doesn't support them.

ScriptView's built-in browser lets you immediately scroll through your reports and diagrams after they are produced. You can create a project file that names all of the scripts belonging to a particular project. This lets you run reports and diagrams on the entire project at once. ScriptView also lets you specify a project header that identifies the report by including the system name, programmer, and copyright notice; this header can be automatically inserted at the top of all the reports for the project.

ScriptView supports a batch mode, so you can run it from the DOS command line or from within batch files or *Paradox* scripts.

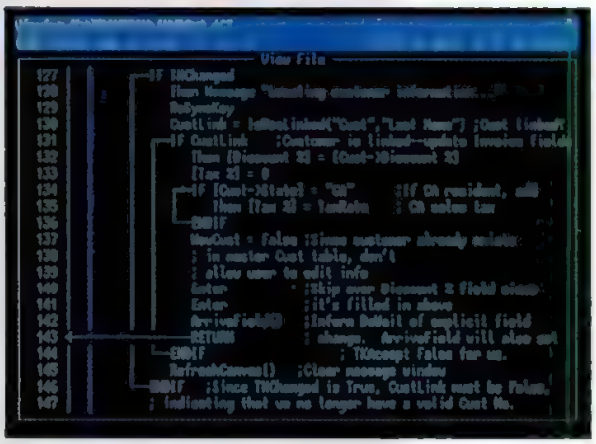

Figure 1: ScriptView lets you create and view graphical action diagrams that highlight the structure of your PAL code.

The current release does not support projectwide (global) cross-reference reports; however, a new release that includes this feature as well as a more friendly TurboVision-style user interface is currently in the works.

ScriptView costs $149. For more information, contact Farpoint Systems Corp., at 335 Grove St., #260, Jersey City, NJ 07302; 800-336-6644 or 201-656-6561.

FIELDSQUEEZE IN PARADOX

I recently had to produce name tags from a *Paradox* database. The names table contained separate fields for first name, middle initial, and last name. In my name tags I wanted a single space separating the first name from the middle initial, and a single space separating the middle initial from the last name. *Paradox*'s FieldSqueeze report setting was turned on to suppress the printing of leading and trailing blank spaces when the value in a field did not fill the field mask.

Unfortunately, the straightforward approach of separating each of the three fields by a space on the report does not work. Whenever the middle initial field is empty, two blank spaces separate the first name from the last name.

The solution, however, is quite simple and demonstrates the consistency of the FieldSqueeze feature. Two fields, separated by a single space, are placed on the report as (AAAAA AAAAAAAAAAAA). The first field is the first name. The second field is calculated using the following expression:

```
[MIDDLE]+" "+[LAST]
```

Now, whenever the middle-initial field is blank, the FieldSqueeze feature takes over and suppresses the unwanted blank space preceding the last name in the calculated field, thereby producing the desired result.

Mohammad Dadashzadeh
Wichita, Kansas

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This is an often-asked question, as the solution is not readily obvious. The FieldSqueeze feature removes leading and trailing spaces from the fields in a report. However, when the fields are defined as follows

```
AAAA AA AAAA
     ^  ^
```

(where the carets indicate spaces) the spaces in between aren't affected by FieldSqueeze, because it deals only with spaces *within* the fields. So when the middle-initial field is blank and therefore removed, there will still be two spaces after the first name.

The solution is to combine the middle-initial and last-name fields into an expression that includes the intervening space; this way FieldSqueeze can operate on the entire expression at once.

When you use this method, FieldSqueeze treats the middle-initial and last name as one combined field and therefore correctly removes a blank middle initial and the space that follows.

Note that in the above-mentioned names table, the middle-initial field is a 2-byte alpha field with space for both the middle initial and a period. Since having to enter the period after the middle initial is tedious, you can use a picture (by choosing ValCheck, Define, Picture on the Edit menu) for the middle-initial field and specify

```
&;.
```

The ampersand (&) tells *Paradox* to convert the initial to uppercase automatically, and the ; . automatically inserts a period when a middle initial is entered. If a middle initial is not entered, the field remains empty.

LET US HEAR FROM YOU

Share your database experience, tips, and techniques; we'll pay you $50 for any submission we print. Mail your submission on-disk, accompanied by a printout, to Databases, *PC Magazine*, One Park Avenue, New York, NY 10016; or upload it to PC MagNet (see page 10 for access instructions). You may also contact Sal Ricciardi via PC MagNet, mailbox 72241,33. We regret that we are unable to acknowledge submissions or answer questions individually. ■

edited by
Sharon Terdeman

Languages

FORMATTING TEXT IN TPW

The wvsprintf function is oriented more for C than for Pascal, but Borland has provided sufficient flexibility in the I/O routines so that a programmer can use the Write statement to achieve comparable formatting miracles. The SWrite unit (Figure 1) lets programmers use the familiar Write and WriteLn procedures to output data. Instead of writing to an output device, the data is stored in a buffer (_Buffer : PChar) that can then be used with ease in any of the Windows functions that take PChar parameters.

Anything that can be passed as a parameter to Write or WriteLn can be properly formatted and output using this method. The SWrite unit interfaces two methods for the programmer to achieve this: the AssignWrite routine, which sets up the I/O functions of the text file passed to it, and the GetLastWritten function, which returns the formatted contents of the last data output using Write.

> ■ FORMATTING TEXT IN TPW: Turbo Pascal for Windows users will find this text file device driver handy for formatting strings.

The Text variable passed to the AssignWrite procedure is typecast as a TTextRec, a record type defined in the WinDos unit. This record type has four pointers to procedures that will be called for different I/O purposes, with the InOut pointer being the key. The function it points to is executed every time a call to Write or WriteLn is made. When this function is called, the BufPos field of the TTextRec contains the number of characters in the buffer pointed to by the BufPtr field. AssignWrite has already assigned BufPtr to point to the PChar _Buffer, so we simply end the PChar with a #0 byte, getting a free ride on the behind-the-scenes formatting methods.

Some precautions have to be taken, though. The InOut function must set the BufPos variable to 0 in order to indicate to its calling routine that it has finished. Also, the BufPtr variable must point to storage

SWRITE.PAS — **COMPLETE LISTING**

```
{$D-,L-,I-,R-,S-,V-}
Unit SWrite;
{**} INTERFACE {**}

PROCEDURE AssignWrite(var F: Text; Size: word;
  Accumulate : Boolean);
FUNCTION GetLastWritten : pChar;
FUNCTION GetLastWrittenC(VAR F : Text) : pChar;

{**} IMPLEMENTATION {**}
USES WinDos;

VAR _Buffer : pChar;   {Buffer to hold text passed to
                        NewInOutFunc. Size set by user}


  FUNCTION GetLastWritten : PChar;
  BEGIN
    GetLastWritten := _Buffer;
  END;

  FUNCTION GetLastWrittenC(VAR F : Text): PChar;
  BEGIN
    GetLastWrittenC := _Buffer;
    TTextRec (F).BufPos := 0;
  END;

  FUNCTION NewOpenFunc(var F: tTextRec): integer; FAR;
  BEGIN
    NewOpenFunc := 104; {file not open for input}
    WITH F DO
      IF Mode=fmOutput THEN {no error if opened with Rewrite}
        NewOpenFunc := 0;
  END;

  FUNCTION NewInOutFunc(var F: tTextRec): integer; FAR;
  BEGIN
    WITH F DO
      BEGIN
        _Buffer[BufPos] := #0; {so routines know where string ends}
        BufPos := 0;
      END;
    NewInOutFunc := 0;
  END;

  FUNCTION NewInOutFunc2(var F: tTextRec): integer; FAR;
  BEGIN
    WITH F DO _Buffer[BufPos] := #0;
    NewInOutFunc2 := 0;
  END;

  FUNCTION NewFlushFunc(var F: tTextRec): integer; FAR;
  BEGIN
    IF F.BufPos>0 THEN
      NewInOutFunc(F); {so that Close will not have to be called
                        to obtain all characters written}
    NewFlushFunc := 0;
  END;

  FUNCTION NewFlushFunc2(var F: tTextRec): integer; FAR;
  BEGIN
    IF F.BufPos>0 THEN
      NewInOutFunc2(F); {so that Close will not have to be called
                        to obtain all characters written}
    NewFlushFunc2 := 0;
  END;

  FUNCTION NewCloseFunc(var F: tTextRec): integer; FAR;
  BEGIN
    FreeMem(_Buffer,F.BufSize+1);
    NewCloseFunc := 0;
  END;

  PROCEDURE AssignWrite(var F: Text; Size: word;
    Accumulate : Boolean);
  BEGIN
    GetMem(_Buffer,Size+1);
    WITH tTextRec(F) DO
      BEGIN
        Mode      := fmClosed;
        BufSize   := Size;
        BufPtr    := pointer(_Buffer);
        OpenFunc  := @NewOpenFunc;
        IF Accumulate THEN
          BEGIN
            InOutFunc := @NewInOutFunc2;
            FlushFunc := @NewFlushFunc2;
          END
        ELSE
          BEGIN
            InOutFunc := @NewInOutFunc;
            FlushFunc := @NewFlushFunc;
          END;
        CloseFunc := @NewCloseFunc;
        Name[0] := #0;
      END;
  END;

END.
```

Figure 1: The SWrite unit implements a simple TFDD that eases the process of formatting strings in Turbo Pascal for Windows.

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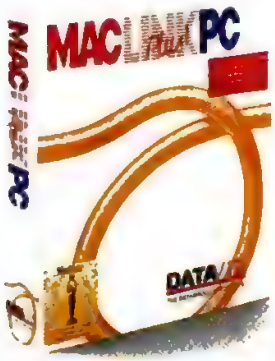

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SWRITEST.PAS — COMPLETE LISTING

```
PROGRAM SWriTest;
USES SWrite, WinProcs, WinTypes;
CONST S : PChar = 'Sin(Pi/2)=';
VAR
  TmpOut : Text;
  R      : Real;
  X      : ARRAY[0..64] OF Char;
  C      : Char;
BEGIN
  AssignWrite(Output, 64, FALSE); {a buffer size of 64 is set here}
  ReWrite(Output);
  Write('Hello World! ');
  MessageBox(0, GetLastWritten, 'start test', mb_Ok);
  R := Pi/2;
  WriteLn('Pi is ', Pi:3:4, S:12, Sin(R):2:2);
  MessageBox(0, GetLastWritten, 'swrite test', mb_Ok);
  Close(Output);
  AssignWrite(Output, 512, TRUE); {Accumulate Writes}
  ReWrite(Output);
  FillChar(X,SizeOf(X),'x');
  X[64] := #0;
  FOR C := '1' to '6' DO
    WriteLn(C,X);
  WriteLn('Accumulated seven lines');
  MessageBox(0, GetLastWrittenC(Output), 'Accumulate Test', mb_Ok);
END.
```

Figure 2: Program SWriTest demonstrates the TFDD contained in the SWrite unit (Figure 1).

of an adequate size or only the last *n* characters written would be output (*n* is the size of the buffer). Finally, the Flush function should call the new InOut function to ensure that all the characters that have been written will appear in the buffer; otherwise, the buffer will only be properly filled when the Close function is called.

All the new I/O functions should return 0 to indicate success unless an error has occurred.

Kenwyn A. Pilgrim
Paterson, New Jersey

The construct created in SWrite is called a text file device driver (TFDD); you can use TFDDs for various purposes, from filtering output to getting input from a serial port. The TFDD in SWrite is about as simple as you can possibly get. It takes advantage of the fact that the built-in Turbo Pascal formatting routines used by Write and WriteLn have already been called by the time the output reaches the InOut function. No matter how many variables of whatever types you passed as parameters to WriteLn, they've all been converted to a simple character stream by the time they reach the InOut function.

As written, the SWrite TFDD accepted only one Write or WriteLn command at a time; it cleared its buffer after each output line. That seemed unfortunate, since the PChar buffer could hold as many as 65,535 characters. I threw in a couple of alternate functions that allow the TFDD to accumulate text, clearing the buffer only after the calling program requests its contents. The program in Figure 2 demonstrates both uses of the SWrite TFDD.

To start, the program assigns the standard Text variable Output to an SWrite TFDD with a 64-byte buffer. It writes a simple text string to the TFDD and displays the output in a message box. Then it writes a more complicated string to the TFDD and displays that. (This is how the original TFDD behaved.)

Next, the program closes Output and reopens it with a 512-byte buffer and the ability to *accumulate* text. It writes seven lines to the buffer and displays the result. As you can see, WriteLn has the desired effect within the message box: It begins a new line. Note that when using the accumulating style, a call to GetLastWritten will *not* clear the accumulated text. To do that, you need a call to GetLastWrittenC, passing the output Text variable.

—*Neil J. Rubenking*

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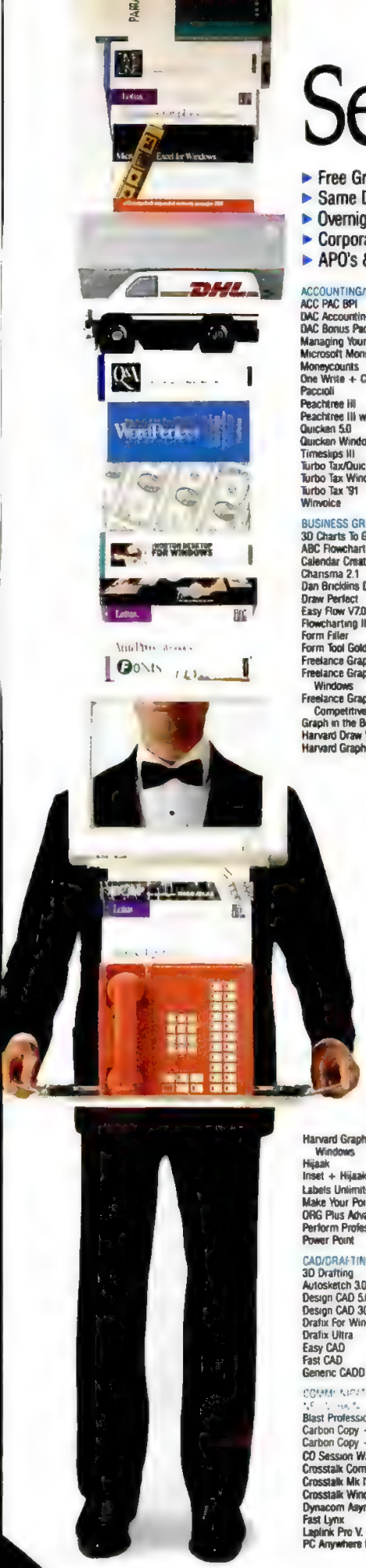

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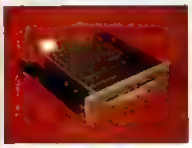

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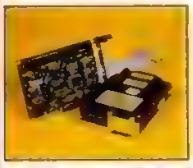

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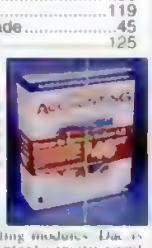

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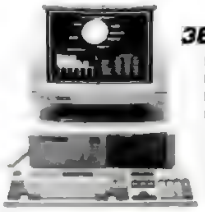

PC320 386SX/20 40MB

- 80386SX 20MHz
- 40mb 17ms hard drive
- 1mb RAM (max 8mb)
- 5.25" & 3.5" floppies
- VGA graphics 800x600
- 2-button Logitech mouse
- 2 serial & 1 parallel ports
- AT 101 keyboard

- Software pre-installed on hard drive: Power Up Menu Screen, MS-DOS 5.0, Microsoft Works 2.0, Smith Corona Word Processing, Desktop Reference, Self Diagnostics, Hardware & Software Tutorial.
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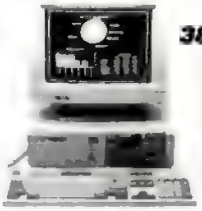

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- 80386SX 20MHz
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- 2mb RAM (max 8mb)
- 5.25" & 3.5" floppies
- VGA graphics 800x600
- 2-button Logitech mouse
- 2 serial & 1 parallel ports
- AT 101 keyboard

- Software pre-installed on hard drive: Power Up Menu Screen, MS-DOS 5.0, Microsoft Works 2.0, Smith Corona Word Processing, Desktop Reference, Self Diagnostics, Hardware & Software Tutorial.
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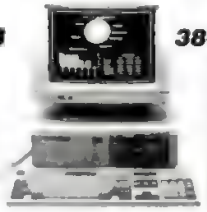

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- 120mb 17ms hard drive
- 2mb RAM (max 8mb)
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- VGA graphics 800x600
- 2-button Logitech mouse
- 2 serial & 1 parallel ports
- AT 101 keyboard
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- Software pre-installed on hard drive: Power Up Menu Screen, MS-DOS 5.0, Windows 3.0, Microsoft Works for Windows, Prodigy, Winfax Pro, Smith Corona Word Processing, Desktop Reference, Self Diagnostics, Hardware & Software Tutorial.
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- 2400 baud modem
- Mouse
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- 2400 baud modem
- Mouse
- 1 parallel, 1 mouse, 2 serial ports
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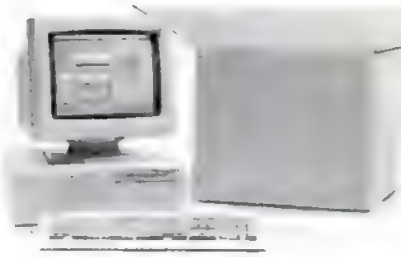

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Premium 386/33	1Meg	500718-002		69 00
Premium II	1Meg	500780-003	WPB	85 00
386SX20 486 25 25E 33	4Meg	500780-004	WPB	179 00
Premium Tower, 386/33TE, 486/25TE 486/33TE	8Meg	500780-001	WPB	360 00

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Z386/33 25 20 33E	1Meg	ZA3800ME	60 00
Z386/33, 25 20, 33E	4Meg	ZA3800MK	189 00
Z248 Z286LP Z386SX	2Meg	Z-605-1 *modules*	109 00
Z486/33ET	4Meg	ZA-4200-M2	399 00
Z486/33ET	16Meg	ZA-4200-M8	849 00

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30F5348 (512K)	30-286	35 00
30F5360 (2Meg)	30-286, 25-286, 50 MTHR BD	99 00
6450375 (1Meg)	80-041	65 00
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	119 00
6451060 (4Meg)	80-A21, A-61 80-A31, 80-111, 80-311	219 00
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79F0999 (2Meg)	LX40, N33SX	99 00
79F1000 (4Meg)	LX40, N33SX	179 00
79F1001 (8Meg)	LX40, N33SX	379 00

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MODEL#	AMT. UPGRADED	CMPQ PART#	PRICE
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	8Meg Module	116561-001	349 00
	32Meg Module	116568 001	1900 00
DeskPro 386/25, 386/20	1Meg Module	113131-001	75 00
	4Meg Module	113132-001	189 00
DeskPro 386S-16MHz	1Meg Exp Bd	113633 001	120 00
	4Meg Exp Bd	113634-001	259 00
	1Meg Module	113646-001	75 00
	4Meg Module	112534 001	199 00
DeskPro 386/20E	1Meg Exp Bd	113644-001	119 00
DeskPro 386/25E	4Meg Exp Bd	113645-001	259 00
	1Meg Module	113131-001	75 00
	4Meg Module	113132-001	189 00
DeskPro 286N 386N 386SX/20, 386/25M, 486/33M, 486S/25M, 486S/16M	1Meg Module	118688-001	64 00
	2Meg Module	118689-001	99 00
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DeskPro 386/16	1Meg Kit	108071-001	119 00
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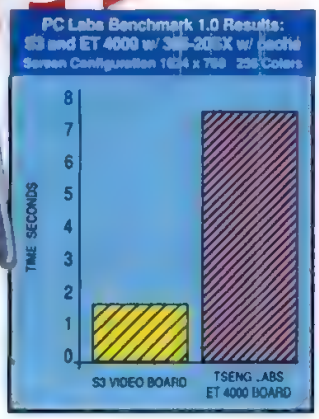

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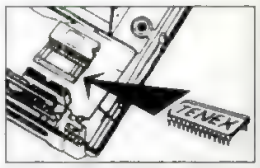

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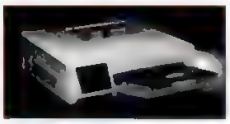

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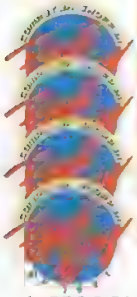

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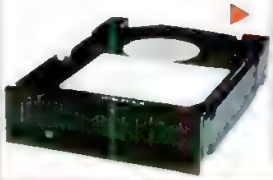

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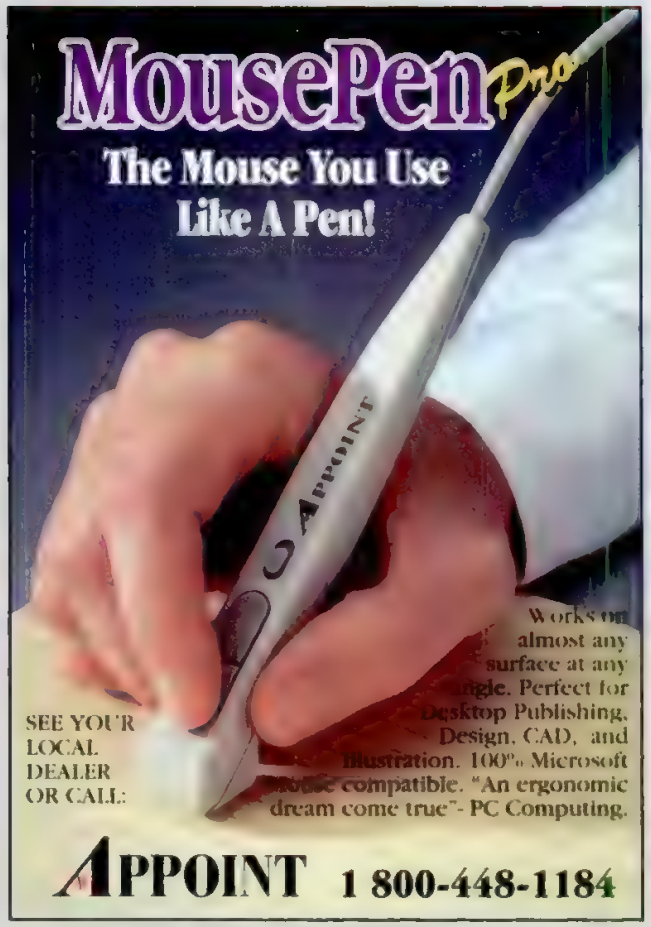

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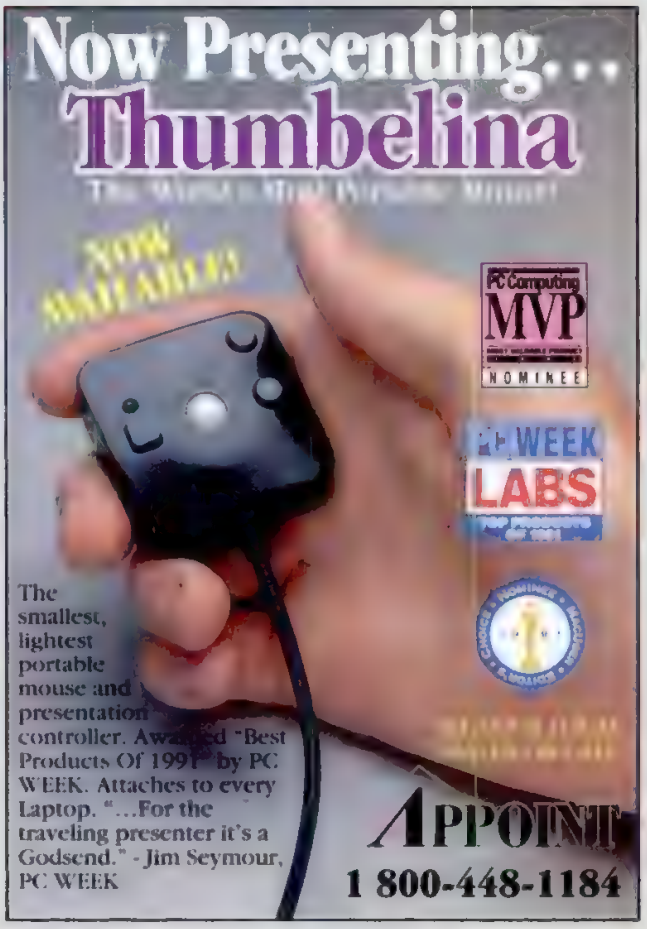

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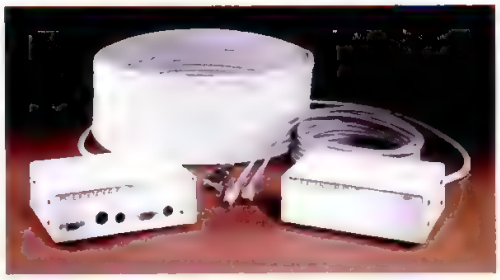

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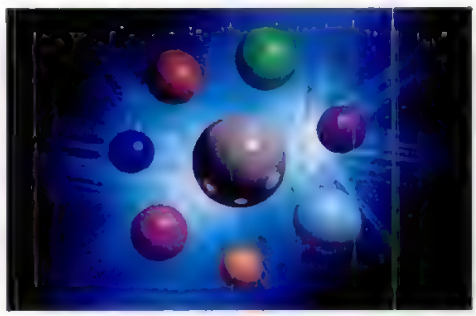

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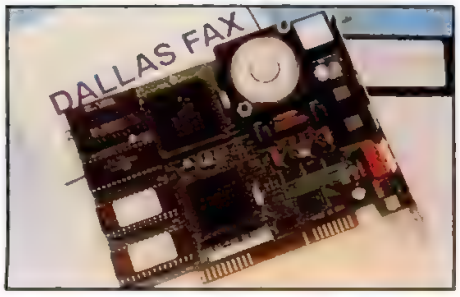

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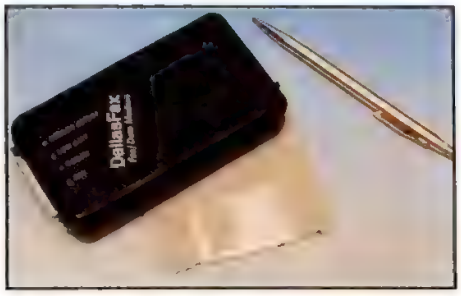

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1201	1202	1203	1204	1205	1206	1207	1208	1209	1210		

PC 4/14-6

1. Do you work in a DP/MIS department?
01.☐ Yes 02. ☐ No

2. Please indicate your company or organization's primary business activity: (Check one only.)
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02 ☐ Manufacturer—Aerospace
03.☐ Manufacturer—Other
04.☐ Systems House
05.☐ Computer Consultant
06.☐ Computer Retailer/VAR/VAD Distributor
07.☐ Communications
08.☐ Finance/Banking/Insurance/Real Estate/Accounting
09.☐ Education
10.☐ Government—Federal
11.☐ Government—Non-Federal
12.☐ Research and Development
13.☐ Data Processing/Computer Service
14.☐ Health/Medical/Legal Service
15.☐ Engineering/Architecture
16.☐ Agriculture/Construction/Mining/Oil/Transportation/Utilities
17.☐ Non-Computer Retailer/Distributor
18 ☐ Other Business or Service
99.☐ Other

3. Please indicate your primary business function: (Check one only.)
01 ☐ DP/MIS
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03.☐ Communications
04.☐ Engineering
05.☐ Res./Dev./Scientific
06.☐ Accounting/Finance
07 ☐ Computer Consulting
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09.☐ Operations
10.☐ Production
11.☐ Education/Training
12.☐ Marketing/Sales
13.☐ Medical/Legal
14.☐ Admin./Mgmt.
99.☐ Other

4. Is your company a reseller?
01.☐ Yes 02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:
01. ☐ 10 or less 03. ☐ 26-99
02. ☐ 11-25 04. ☐ 100 or more

6. Are there any PCs in your office? (Check all that apply.)
01.☐ Linked to mainframe
02.☐ Linked to mini
03.☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply.)
01.☐ IBM or Compatible PCs
02.☐ IBM or Compatible Mainframes
03.☐ IBM or Compatible Minis
04.☐ Macintosh

8. Do you plan to buy any PC Products?
01.☐ Now
02.☐ In 4 to 6 months
03 ☐ In 7 to 12 months
04.☐ No definite plans

9. Number of Employees in your entire company:
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02 ☐ 26-99
03.☐ 100-499
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05.☐ 1000 or more

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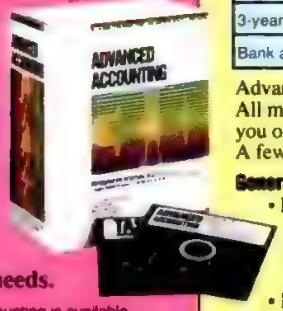

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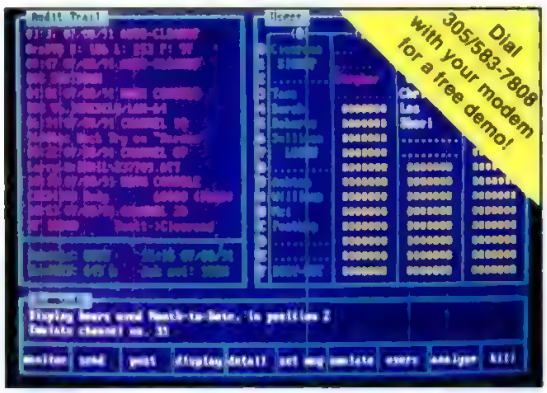

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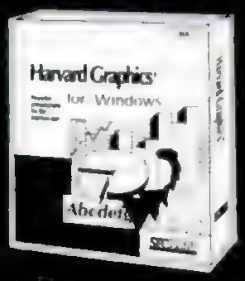

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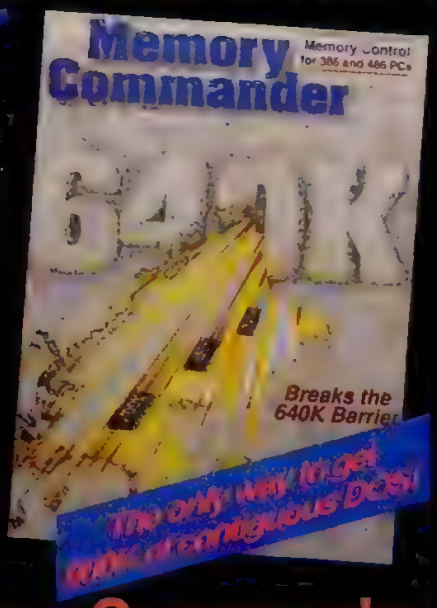

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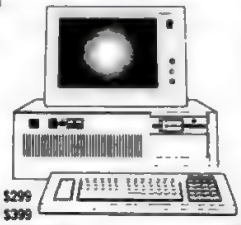

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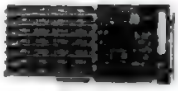

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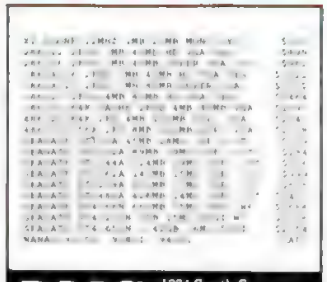

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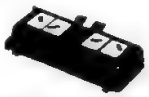

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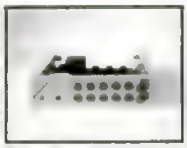

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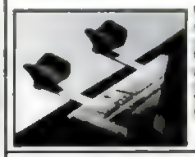

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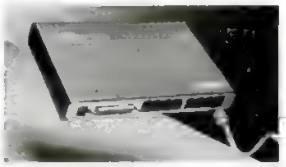

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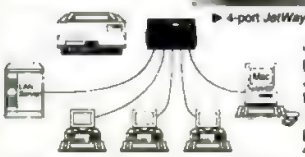

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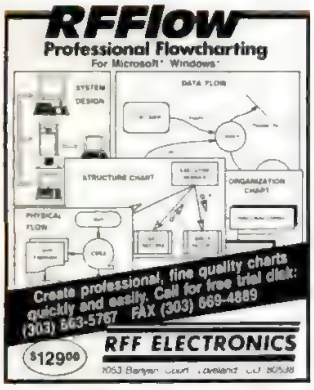

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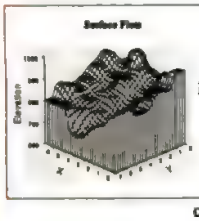

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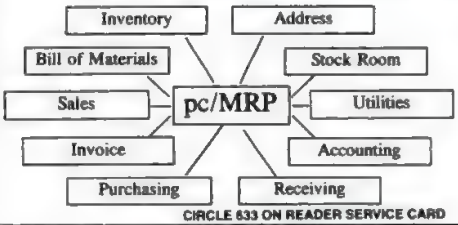

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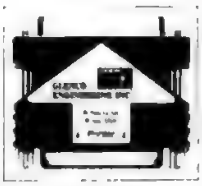

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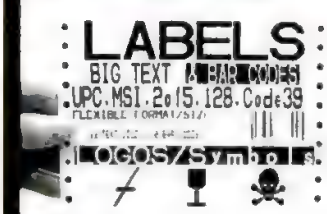

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PC MAGAZINE Coming Up

■ WINDOWS VS. OS/2
It's not often that major upgrades to two important operating systems are released simultaneously. How do they compare, and is now the time to make the move from DOS? *PC Magazine* looks at what you get with the new releases and what's planned for the future.

■ WINDOWS 3.1
Windows 3.0 changed the face of computing, but it still had its problems. Unrecoverable Application Errors (UAEs) were far too common and the file management system was painfully slow. Version 3.1 of Windows smooths out most of the rough edges and adds exciting new features such as multimedia and *TrueType* support. We tell you what's new and improved.

■ OS/2 2.0
It's been a long time coming, but OS/2 2.0 was finally released in March of this year. Was it worth the wait? *PC Magazine* takes an in-depth look at this intriguing new operating environment—the first PC-based 32-bit operating system and a new, object-oriented GUI. What new features does it have? Is it hard to install? Can you run it on your existing machine? Is it, as promised, a better DOS than DOS and a better Windows than Windows? Our review answers all these questions and more.

■ WINDOWS TIPS
Experts offer more than 35 practical tips to help you install, optimize, customize, manage, and troubleshoot Windows 3.1. Novices and experienced users alike will find food for thought on subjects as diverse as changing icon-title fonts and paring your 3.1 configuration to the bone for laptop installation.

■ COMPATIBILITY GUIDE
Will your graphics adapter, printer, or utilities take full advantage of Windows 3.1? *PC Magazine*'s Windows 3.1 Compatibility Guide puts you in the picture.

■ WINDOWS 3.1 FILE LISTING
Find out at a glance what each Windows 3.1 file is for—and whether or not you need it.

■ AMD 386SX/25 PCs
Advanced Micro Devices' 25-MHz Am386SX chip provides a speedy alternative in entry-level 386SX computing. In this review, *PC Magazine* tests 17 new 386SX/25 PCs, from Ares, Atel, AUVA Computers, Clover, Club AT, Diamond, LANtek, Master, Micro Express, National Micro Systems, Northgate, Premier, SST, Tangent, Transource, Twinhead, and Wang Labs.

■ UTILITIES
Next issue's utility, WPRINT, is our first program that will work with Windows, Version 3.1. It is designed to take advantage of the new drag-and-drop capabilities. All you'll have to do is simply run WPRINT, click on a text or bitmap file, drag it to the WPRINT icon, and continue with your work; WPRINT will print out your file. ■

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After Hours

Products for the Leisure Side of Personal Computing

The PC's Fantastic Voyage: A Trip Inside The Human Body

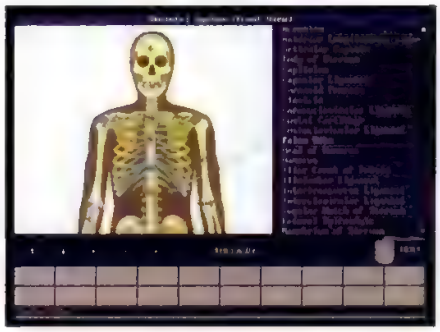
ANATOMY
by Don Trivette

Got a sharp pain in your left side? Could it be your spleen? Your gallbladder? That's just one common anatomical question that *Bodyworks: An Adventure in Anatomy* can easily answer.

Bodyworks is the ultimate owner's manual and parts list for the human body. Designed for the average man or woman, Software Marketing Corp.'s $79.95 program will show you where muscles, nerves, bones, ligaments, and organs are located and how they work.

A mouse interface makes *Bodyworks* simple to use; the material is organized clearly and concisely. A large window at the top of the screen displays full-color anatomy drawings and a control panel at the bottom lets you zoom in/out, up/down, and left/right, or choose one of ten biological systems for display. Icons represent the skeletal, digestive, muscular, lymphatic, endocrine, nervous, cardiovascular, reproductive (male and female), and urinary systems. To check out the digestive system, for example, click on the stomach icon and scroll the screen to the trunk of the body.

Part names listed on the right side of the screen correspond to tiny tick marks on the anatomy. Clicking on either the mark or the name causes a line to connect the two, thus identifying the part. A few clicks in the abdominal cavity and you'll quickly see the green gallbladder on the right, the yellow spleen on the left, and the pink transverse colon that lies between the two organs.



***Bodyworks* pinpoints major skeletal features with tiny tick marks that correspond to the anatomical names at right. The skeleton is one of ten systems presented in *Bodyworks*.**

- **ANATOMY**
  A.D.A.M. Software: A high-resolution look inside the human body
- **GAMES**
  Windows Entertainment Pack, Volumes II and III, WinGames Casino Pack 1, and *World Champion Cribbage:* Make your GUI fun.

This software has a lot more to recommend it than colorful drawings. A click on the right mouse button brings up a wonderfully nontechnical description of the part and how it works. The gallbladder, I learned, gets fluid from the liver that it converts into bile. It releases the bile into the small intestine, where it helps digest the fat in foods. I must have learned this once in biology, but somehow it's much more vivid and memorable with a full-color gallbladder staring me in the face. For those who want more life in their body parts, there are three animated sequences demonstrating lung, heart, and muscle action.

You can also directly search the many hundreds of items in *Bodyworks*' comprehensive online index. I spent an afternoon browsing through diagrams, close-ups, and text about such dissimilar subjects as taste buds,

CONTINUES

A.D.A.M. SOFTWARE: Gray's Anatomy Meets the Computer Age

While *Bodyworks* is designed for the biologically curious, *A.D.A.M. Software* is another anatomy program aimed at medical schools and practicing physicians.

In this CD-ROM–based program, the easy way to get under *A.D.A.M.*'s skin (the acronym stands for Animated Dissection of Anatomy for Medicine) is with the dissecting slidebar. Moving it down peeled back 20 layers of the foot, including fat layers, superficial veins, and the cutaneous nerves. Eventually I got down to muscle and bone. As each new layer appeared, the names of the parts were highlighted in a window on the lower right. Anatomical layers can also be selected by clicking on the names in this window. The third way to open *A.D.A.M.* is by turning the cursor into a scalpel and manually carving it up. Illustrations are available for all four views with cross sections located at significant points.

A vertical panel of buttons in the middle of the *A.D.A.M. Software* screen controls some interesting features. The pathology button, for example, selects and positions various disfigurements and medical problems. Warts, corns, moles, and ulcers can be placed on the skin—demonstrating to a patient or student how these abnormalities might appear and be treated. *A.D.A.M. Software*'s device button brings up screws, pins, and implants; an animation button presents a slide show

CONTINUES

***A.D.A.M.*'s right foot, dissected to show the bone structure and connecting ligaments. The dissecting slidebar is located at the top of the center control panel.**

Bodyworks

CONTINUED

surfing injuries, color vision, ear wax, and the zygomaticus minor muscle. The text is detailed enough to answer my questions without being overly medical.

To get an authoritative opinion, I sent *Bodyworks* to a friend in medical school. He loaded it on the PC in his anatomy lab, where it attracted a great deal of attention. He and his classmates concluded that *Bodyworks* is not detailed enough for their studies (it is generally missing fine details, cross sections, and left, right, and rear views), but it is a good review tool.

Bodyworks shows how graphical software can be an excellent learning and reference tool; it should be in every high-school library, biology class, rescue squad, spa, health club, and doctor's office. If you are at all interested in your own body, *Bodyworks* should have a place in your library, too.

List Price: *Bodyworks: An Adventure in Anatomy*, $79.95. **Requires:** 512K RAM, 2.5MB hard disk space, DOS 2.2 or later. Mouse recommended. Software Marketing Corp., 9831 S. 51st St., Suite C-113, Phoenix, AZ 85044; 800-545-6626, 602-893-2400.

CIRCLE 496 ON READER SERVICE CARD

A.D.A.M. SOFTWARE (CONTINUED)

of a dozen common surgical procedures.

To get the resolution necessary to produce the beautifully detailed illustrations, *A.D.A.M.* requires Windows 3.0 and a display that supports 1,024-by-768 resolution with 256 colors. A CD-ROM drive and 4MB RAM are also required.

A.D.A.M. is being developed in five modules, the first of which—the lower extremities—is complete. Composed of the foot, knee, and hip, the first module is being sold to orthopedic surgeons and podiatrists. A team of programmers and medical illustrators is now working on the abdominal/pelvic region, with modules planned for the thorax, the upper extremities, and the head/neck. A.D.A.M. Software says *A.D.A.M.*'s entire body will be finished by the third quarter of 1993. Each module is separately priced; the lower extremities costs $2,000. The company intends to offer a discount on the entire body, but even so, it will take $12,000 to $14,000 to assemble the whole man.

—*Don Trivette* ■

List Price: *A.D.A.M. Software* (core lower extremities), $2,000. **Requires:** 640K RAM, CD-ROM drive, VGA display with 1,024-by-768 resolution and 256 colors, Microsoft Windows 3.0 or later, MS-DOS CD-ROM Extensions. Mouse recommended. A.D.A.M. Software Inc., 1899 Powers Ferry Rd., #460, Marietta, GA 30067; 800-755-2326, 404-980-0888.

CIRCLE 496 ON READER SERVICE CARD

Windows: It's a Fun Place to Mouse Around

GAMES
by Barry Simon

Quick, what's the first Windows application for most new users? If you answered Solitaire, you could well be right. After all, playing cards is much more fun when someone takes care of the shuffling and dealing for you. Games have long played a role in the marketing of Windows. Version 2.*x* had Reversi, 3.0 added Solitaire, and Windows 3.1 will include Mine Sweeper.

Spurred by the development of games by its in-house programmers, Microsoft introduced the original *Windows Entertainment Pack* in the fall of 1990 and was surprised to find itself on the Top Ten games lists. Microsoft began collecting programs for *Volume II* and wound up with so many that it has introduced two new releases: the *Windows Entertainment Pack, Volumes II* and *III*. We'll also look at a bunch of other games—30 in all—that will make your Windows computing fun. All the packages require a PC running Microsoft Windows, and most take good advantage of the mouse.

Windows Entertainment Pack, Volume II

The two new versions of the $39.95 Microsoft *Windows Entertainment Pack* both come with seven games and the IdleWild screen blanker. Each pack has different blanking modules; there are 22 modules across all three packages. It's a usable blanker but certainly not in the same league as ICOM's *Intermission* or Berkeley Systems' *After Dark*.

Entertainment Pack, Volume II, has two solitaire games. Tut's Tomb is a version of Pyramid. You start with a seven-row pyramid. You must pair off the exposed cards or those turned up from the pile into combinations that add up to 13. FreeCell is a game where all the cards are drawn face up; you must get the cards into four piles of increasing order, one in each suit, using nothing but four free cells and standard card building. Both games are of medium difficulty.

Also in *Volume II* is JigSawed, a somewhat limited jigsaw puzzle that will load and scramble any .BMP file and various other bitmapped files. A weak point is that you can't adjust the size or the number of pieces. A bigger disappointment is RattlerRace, which features a tiny apple-eating snake that you turn with cursor keys.

Much better are Stones and Rodent's Revenge. Stones requires you to place tiles on a board. Each tile has a symbol and background and foreground colors. Except for wildcards, touching tiles must agree in two of their three attributes—a fascinating and subtle game. Rodent's Revenge has a mouse pushing bricks to trap cats; it requires quick wits and a good sense of geometry.

The find in *Volume II* is Pipe Dream, and it's well worth the price of admission all by itself. You lay down pieces of pipe in a rectangular grid. Each piece is horizontal, vertical, crossed, or one of the six possible corners. After a while, green goo starts flowing through your pipeline. Your challenge is to lay pipe fast enough (and correctly) to pre-

CONTINUES

The star of *Windows Entertainment Pack, Volume II*, is Pipe Dream, where you have to lay pipe quickly to keep ahead of the green goo.

Windows

CONTINUED

vent the goo from leaking out. If you play properly for long enough, you get to the next level.

As you progress from one level to the next, you get extra problems and interesting tile types. Every fourth level is a bonus with a different strategy. Like Mine Sweeper in the original *Entertainment Pack*, Pipe Dream has an addictive fascination that will keep you coming back for more. It's not a game to start up when you have a deadline looming!

Windows Entertainment Pack, Volume III

The *Windows Entertainment Pack, Volume III*, has a different flavor. There is only one card game, TriPeaks, instead of the two or more in the other packs. In TriPeaks, you lay cards off from an array by building in either direction. Also, *Volume III* has a word game and two sports games, both new game types for the *Entertainment Pack* series. WordZap requires you to race the computer in spelling out words from an array of letters. You set how fast the computer finds words so it can be fun for anyone.

One sports game, SkiFree, has some funny graphics but is not very extensive. On the other hand, Fuji Golf features 18 holes of golf with a rich set of features—bunkers, water hazards, roughs, fairways, and greens. Without doubt, it is the star of this pack.

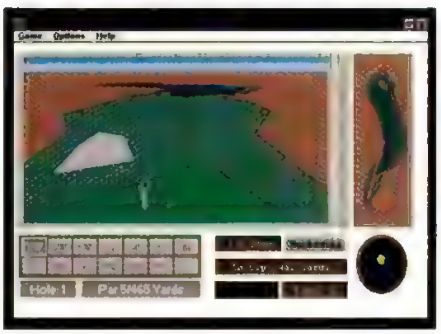
Rounding out the third pack is the best version of Conway's game of Life I've seen on a computer (it allows two species of life that you can place with the left and right mouse buttons), a dominoes relative called Tetra-Vex, and a puzzle game. Klotski is a geometric brain teaser based on wooden Polish puzzles (called *klotskis*) and comes with 24 of them. It is licensed from ZH Computer, which sells a more extensive $49.95 version that lets you make your own klotskis (contact ZH Computer, P.O. Box 35764, Edina, MN 55435, 612-432-8461).

My only serious complaint about the *Windows Entertainment Pack, Volumes II* and *III*, is their lack of printed documentation; you're limited to the online help. Sometimes, this help is nonexistent (SkiFree) or doesn't discuss all the rules (Pipe Dream).

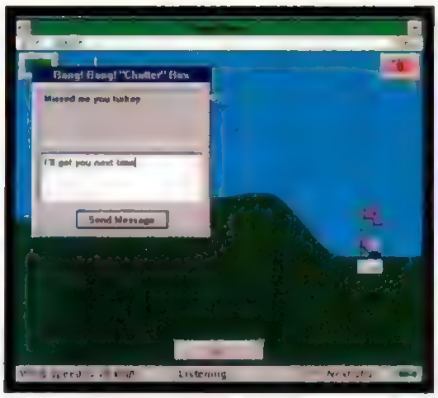
Still, at 5 bucks per game, these are tremendous bargains! Pipe Dream is so wonderful that it makes *Volume II* the pack to get if you're only getting one, but you should consider getting both.

List Price: *Windows Entertainment Pack, Volumes II* and *III*, $39.95 each. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 206-882-8080.

CIRCLE 497 ON READER SERVICE CARD



Microsoft's *Windows Entertainment Pack, Volume III*, includes a sophisticated golf game, Fuji Golf.



WinSoft's Bang! Bang! is a one- or two-person game with cannons shooting at each other alternately. It can be played long distance via modem and includes a chat window.

WinGames

WinSoft's $39.95 *WinGames* follows Microsoft's pattern, offering a mix of eight games at the same price as Microsoft's *Entertainment Packs*. There are four brain teasers, three arcade games, and one that doesn't exactly fit into either category—CuBIC. WinSoft did a very good job with the graphic representation of the cube on-screen, but CuBIC proves awkward to play with a mouse, especially when compared with the original Rubik's Cube. The computer opponent in Checkers plays a pretty good game against a duffer like me (or you can play it against a human opponent), but the graphics are not very well done. Yacht is a version of the dice game Yahtzee. Designed for one or two players, it's an excellent implementation.

My favorite in the whole package is a game called Code Breaker. In the default mode, there is a hidden code of four colored pegs. Each peg can be one of six colors, and yes, order counts. You make a guess at the code and the computer tells you the number in the right position and the number of additional ones of the right color but in the wrong position. You get ten guesses. I never lost, but just figuring out the code from the information provided me with hours of enjoyment. You can adjust the number of colors, number of pegs in a code, and the number of guesses allowed.

Chopper Attack is a standard arcade game in which you have to shoot down helicopters and paratroopers. Alien Force is a more intriguing shoot 'em up; you play in a maze. WinCommand is based on the Gulf War: SCUD missiles come in and you need to use your Patriot missiles to shoot 'em down.

Bang! Bang! is a two-person game with cannons shooting at each other alternately. You adjust the speed and angle of inclination of your cannon. Each round features differing wind speeds and terrains to challenge you. You can also play this game by modem with someone else who has a copy. It worked well in this mode except that disconnecting the link failed to hang up my modems. On a continuum, I'd rank *WinGames* between *Volumes II* and *III* of the *Windows Entertainment Pack*.

List Price: *WinGames*, $39.95. WinSoft, 18732 142nd Ave. NE, Woodinville, WA 98072; 800-275-7638, 206-485-7329.

CIRCLE 498 ON READER SERVICE CARD

Casino Pack I And World Champion Cribbage

Moon Valley Software's $39.95 *Casino Pack I* has three Las Vegas–style games: Video Poker, Keno, and Blackjack. These are the relatively easy games of chance, but without the thrill of betting real money. All three are well done; they're filled with the extras you'd hope for, such as doubling up in Poker and splitting your hand in Blackjack. If you want to practice for Las

***Casino Pack I*'s Poker features good graphics and some sophisticated betting extras, like doubling up.**

CONTINUES

Windows

CONTINUED

Vegas, *Casino Pack I* is for you.

Ninga Software's $39.95 *World Champion Cribbage* is a realistic version of the famous card game with an on-screen Cribbage board. The computer's skill was adequate: I'm an experienced Cribbage player, and I lost to the computer just about as often as I won. I was particularly impressed with the Sound Blaster support. Too often, programs providing such support try to wow you with loud effects. Instead, this game has some discrete card shuffling and the sound of pegs being inserted into the Cribbage board.

The game board in Ninga Software's *World Champion Cribbage* has pegs that click as they are moved.

List Price: *Casino Pack I*, $39.95. Moon Valley Software, 706 E. Bell Rd., #112, Phoenix, AZ 85022; 800-473-5509, 602-375-9502.

CIRCLE 499 ON READER SERVICE CARD

List Price: *World Champion Cribbage*, $39.95. Ninga Software, 736 8th Ave. SW, #330, Calgary, Alberta, Canada T2P 1H4; 800-265-5555, 403-265-6611.

CIRCLE 500 ON READER SERVICE CARD

Deluxe Solitaire

If you're a Solitaire freak, then WinWare's $49.95 *Deluxe Solitaire* is for you. It beats Microsoft at its own game. There are 40 different games, from the familiar Klondike, Golf, Pyramid, and Canfield to others that were new to me, including Agnes and Tam-O'Shanter.

Like the original Windows Solitaire and the game packs, double-clicking on a card causes it to make a legal move—but unlike the Microsoft offerings, *Deluxe Solitaire* doesn't miss many possibilities. And it's card-back animation goes an extra step—one back is a winter scene with falling snow! WinWare's package offers save/restore and multiple levels of difficulty.

List Price: *Deluxe Solitaire*, $49.95. WinWare, 7438 Lynworth, Dallas, TX 75248; 214-458-0540.

CIRCLE 501 ON READER SERVICE CARD

Four Shareware Gems

Shareware has done its part as well, producing some excellent Windows games. Here are four favorites, available on PC MagNet. All four games can be downloaded from MagNet's After Hours forum, in the Games Library.

Columns is a free game from Australia—a variant of *Tetris*. All the falling blocks are vertical and three boxes in size. All you can do is cycle through the arrangements of the three colors assigned to those boxes. The object is to get together sets of three boxes of the same color. It is a simple concept, but the game is fascinating to play.

Among the shareware Windows games are *Columns* and *Attaxx*. While they are relatives of *Tetris* and Reversi, they have a richer flavor.

Yacht-Z is a $10 shareware Windows version of the famous dice game. It's one-player triple Yahtzee but not as flexible as Yacht in *WinGames*. Still, at $10, it's both fun and a bargain.

Attaxx for Windows ($14.95) is another shareware game. It's a relative of Reversi but more subtle. You lay down stones on a rectangular grid, trying to capture those of your opponent. Because the game board has different squares blanked out with each game, you need to adopt more than one strategy against the computer.

The $12 shareware game *Blackout* is a hand-eye coordination game played with a large colorful array of blocks. Among the blocks are targets you must hit using your mouse. If you miss and click on a normal block, a 3-by-3 array blacks out. As each round progresses, blocks black out at random. You have to get all the targets before total blackout. With Sound Blaster support, boogeymen, and bonus blocks, *Blackout* is a rich, entertaining game.

List Price: *Columns*, Version 1.1, free. Happiware, John Rotenstein, P.O. Box 165, Double Bay, NSW 2028, Australia.

CIRCLE 502 ON READER SERVICE CARD

List Price: *Yacht-Z*, Version 1.01, $10, shareware. Bob Dolan, 237 Willis Ave., Rochester, NY 14616.

CIRCLE 503 ON READER SERVICE CARD

List Price: *Attaxx for Windows*, Version 1.0, $14.95, shareware. Millennium Computer Corp., 642 Kreag Rd., Pittsford, NY 14534; 716-248-0510.

CIRCLE 504 ON READER SERVICE CARD

List Price: *Blackout*, Version 2.4, $12, shareware. Zarkware, 2243 E. Thompson, Springfield, MO 65804.

CIRCLE 505 ON READER SERVICE CARD

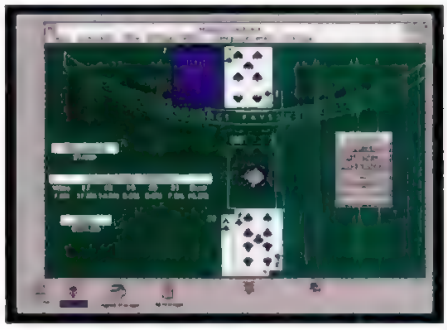
From DOS to Windows, And Then on to Las Vega$

GAMES
by Matthew J. Ross

Masque Publishing, formerly known as MicroAce, has ported its DOS-based Blackjack tutor to Windows. *Masque BlackJack for Windows* gives any budding card shark all the gambling savvy needed to play with the odds on your side. With single- and four-deck options and on-line advice on splitting your hand and doubling down as well as an excellent manual, *Masque* gives you everything you need for your trip to Vegas (except luck!).

List Price: *Masque BlackJack for Windows*, $49.95. Masque Publishing, P.O. Box 5223, Englewood, CO 80155; 800-756-4223, 303-290-9853.

CIRCLE 506 ON READER SERVICE CARD



***Masque BlackJack for Windows* shows you how to play with the odds in your favor, while *Win Roach*, running in the background, gives a creepy feeling to your Windows desktop.**

Those Are Bugs, Not UAEs!

And what would a computer program be without bugs? Well, New Generation Software has got plenty—of bugs, that is. Its shareware applet, *Win Roach* 2.11, sends up to ten cockroaches scurrying across your (Windows) desktop, but some deft hand-eye coordination and a quick click of the mouse will leave these pests crunched! ■

List Price: *Win Roach*, Version 2.11, $29.95. New Generation Software, P.O. Box 890482, Houston, TX 77289; 800-964-7638, 713-283-6760.

CIRCLE 507 ON READER SERVICE CARD

by Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing

The Energizer Bunny Was Crushed. He So Wanted to Run Persuasion And Word for Windows!

"Santa Clara, Calif.–based Poqet Computer will use the pulpit of Wednesday's Pen Computer Users Conference in Baltimore to introduce a handheld, pen-based system designed for vertical field sales and service applications. The machine will be powered by AA batteries and hence will not be powerful enough to run Windows."

—*ComputerWorld*, January 1992

UAE Redefined

"Most of the reported new features seem to be aimed at making the developers' task easier. Some of the new features include a parameter validation system, to help eliminate Unreasonable Application Errors (UAEs)."

—*Bay Area Computer Currents*, August 27–September 9, 1991

This 386-33 sold by Amos Computer & Software, Olympia, Washington, features 8 "explanation slots."

—*Olympian*, September 10, 1991

CARTOON: RICHARD TENWANT

Classified Intelligence

"A 486/338 megs, 120 meg. HD, 128K Ram Cache, 1.2 & 1.4 flopies, VGA. New, 1 yr. warranty. Wife says it goes or she goes! $2305."

—*Dayton* (Ohio) *Daily News*, December 1991

Amazing Facts

"The secret is in a process called refreshing or repainting the screen. Every sixty seconds the electron gun at the back of the tube paints a stream of electrons line-by-line, starting from the upper left-hand corner of the screen and working its way to the bottom right-hand corner. The process of refreshing the screen happens so fast that the user cannot detect any flicker of the characters."

—*The Professional Secretary's Handbook* (Houghton Mifflin)

Databank Cuts Through the Hype and Explains Exactly Why You Need a Tower

"Databank 386SX Computer. The reliability of the 386SX computer, with the convenience of the space saving tower unit, together in this great offer! The tower unit stands on the floor next to your desk or work station, freeing up the space usually needed for the hard drive."

—Heartland America mail-order catalog

Products we never knew we needed (until advertising showed us the way): a pouch to protect our audio and data CDs from nasty airport X rays, from the CompuAdd Summer 1991 catalog.

NEVER ANYTHING like it before! **THE LITTLE BLACK BOOK OF COMPUTER VIRUSES** teaches you how to create living viruses, with working examples and com... $14.95 ppd. Americ...

Do-it-yourselfers will find lots of great projects in the classified ad pages of *Popular Science* (December 1991). Next month's ad: concocting plastique out of ingredients available in any home?

We hope that's a typo in this ad from the Programmer's Shop.

Public domain virus production utility. Builds ... table of all files on the hard disk and checks fi... they are modified. Protect against most virus...

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of each entry are considered. Winners this issue: Jim Nuccio (AA batteries versus Windows), Michael Dial (Databank frees hard drive space), David Berkowitz (computer viruses), Greg Olds (virus production), Bill Beattie (unreasonable application errors), Sherwood P. Smith (8 explanation slots), Charles R. Holdren (wife goes or computer), Russell O. Wulff (60-second refresh), David Frankenbach (X ray shield).

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System includes:

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- 50 MB hard drive
- VGA Color Monitor
- 1024 x 768 integrated video support
- Expandable to 8 MB RAM
- 3 16-bit expansion slots
- 1 floppy drive

Dell 486P/16 16 MHz i486SX System.
System includes:

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- 50 MB hard drive
- VGA Color Monitor
- Upgradeable processor design
- 1024 x 768 integrated video support
- RAM expansion to 64 MB
- 1 floppy drive

Dell 486P/25 25 MHz i486 System.
System includes:

- 2 MB RAM
- 50 MB hard drive
- VGA Color Monitor
- Upgradeable processor design
- 1024 x 768 integrated video support
- RAM expansion to 64 MB
- 1 floppy drive

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Timeframe	i486	i486SX	i386	i386SX	Notebook	Other
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3-6 months						
6-12 months						
More than 12 months						

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